PROCEEDINGS OF THE CHIEF CONSERVATOR OF FORESTS
No 498, PRESS, DATED THE 11TH NOVEMBER 1932

2281/2111

7535

REVISED WORKING PLAN

FOR THE

MOUNT STUART FORESTS
SOUTH COIMBATORE DIVISION

(TMFD)

BY

M. V. LAURIE, Esq., I.F.S.,
Under the direction of C. C. Wilson, Esq., I.F.S., Conservator of Forests

2281/2111

MADRAS
PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS

1933

PROCEEDINGS OF THE CHIEF CONSERVATOR OF FORESTS
No. 498, PRESS, DATED THE 11TH NOVEMBER 1932

REVISED WORKING PLAN

FOR THE

MOUNT STUART FORESTS SOUTH COIMBATORE DIVISION

BY

M. V. LAURIE, Esq., I.F.S.,
Under the direction of C. C. Wilson, Esq., I.F.S., Conservator of Forests

◆

MADRAS
PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS

1933

INTRODUCTION.

Mr. Wood's working plan for the Mount Stuart Forests, which came into force in 1919, was to a great extent departed from after a few years of working. The order of the fellings was altered almost from the start, in order to fit in with existing transport facilities ; the areas clear-felled and regenerated each year exceeded all expectations, and rendered the previous selection of suitable localities outside the annual selection felling coupes necessary ; extraction facilities threatened to become inadequate, and various other prescriptions of the plan, such as fire-protection, lantana eradication, etc., were found to be becoming unsuitable to the altered conditions of working. Accordingly in September 1927 a conference consisting of the Chief Conservator of Forests, Conservator, Working Plans Circle, Conservator, Fifth Circle, Chief Forest Engineer, District Forest Officer and others was held at Top Slip to discuss the revision of the working plan to decide the policy and broad outlines of the prescriptions to be adopted. No reconnaissance report was made for the present plan, the decisions of this conference taking its place.

Among other things, a 100 per cent enumeration of the growing stock with a complete contoured topographical survey of the workable area was decided upon, and the writer was appointed as Working Plans Officer in September 1927 to carry it out.

The enumeration and survey took three years to complete, and the compilation of maps and enumeration figures, and the writing of the plan were not finished until March 1931. From December 1930, Mr. R. B. Cornwell was attached to the Working Plans Circle to assist in the completion of the plan.

The following rangers were engaged on the field work, and compilation of maps and statistics :—

Ranger M. N. Raman Pillai, from 21st September 1927 to 28th February 1929.

Ranger K. G. Monnappa, from 12th January 1928 to 17th August 1929.

Ranger K. Raghavan, from 7th October 1928 to 2nd October 1929.

Ranger C. R. Raghunathan, from 4th July 1929 to 12th September 1929.

Ranger K. Jayarama Ayyar, from 12th September 1929 to 3rd October 1930.

Ranger K. K. Appayya, from 23rd August 1929 to 22nd December 1930.

Ranger U. Vriddhachalam Pillai, from 23rd August 1929 to 1st April 1931.

Most of the statistics regarding past yields, past revenue and expenditure, prices, working costs, etc., have been furnished by the District Forest Officer. In most cases it has not been possible to verify the figures supplied, though this has been done whenever a check could be made. The historical sections previous to 1915 incorporate all the information given by Mr. Wood in Part I of his plan, and have been amplified from various sources.

The Working Plans Officer would like to take this opportunity of thanking the officers and subordinates of the South Coimbatore district, and of Tunacadavu range in particular for the assistance they have rendered throughout the preparation of the plan.

DEHRA DUN,
The 18th May 1931.

M. V. LAURIE,
Working Plans Officer, Mount Stuart.

TABLE OF CONTENTS.

PART I.

Summary of Facts on which the Proposals are based.

CHAPTER I.—DESCRIPTION OF THE TRACT DEALT WITH.

Sections.	PARA.	PAGE
1. Name and situation	1	1
2. Configuration of the ground	4	2
3. Geology, rock and soil	5	2
4. Climate	6	2
5. Water-supply	13	3
6. Distribution and area	21	4
7. State of the boundaries	24	5
8. Legal position	25	5
9. Rights and concessions	26	5

CHAPTER II.—THE FOREST.

1. Composition and condition of the crop	28	6
2. Injuries to which the crop is liable	55	13

CHAPTER III.—UTILIZATION OF THE PRODUCE.

1. Agricultural customs and wants of the population	75	16
2. Markets and marketable products	78	17
3. Lines of export	91	20
4. Methods of exploitation and their cost	118	23
5. Past and present prices	137	26

CHAPTER IV.—STAFF AND LABOUR-SUPPLY.

1. Staff	153	32
2. Labour-supply	158	33

CHAPTER V.—PAST SYSTEMS OF MANAGEMENT.

1. General history of the forest	162	34
2. Past systems of management and their results	226	44
3. Do. (1918 to 1930)	260	50
4. Special works of improvement undertaken	303	58
5. Past yield	321	60
6. Past revenue and expenditure	326	63

CHAPTER VI.—STATISTICS OF GROWTH AND YIELD.

1. Statistics collected previous to the preparation of the present plan	333	65
2. Statistics collected during the preparation of the present working plan—Enumeration and topographical Survey	337	67
3. Enumerations in the Palakadavu block	359	71
4. Enumeration in Karian Shola	361	71
5. Preparation of volume tables	362	72

CHAPTER VII.—ESTIMATE OF CAPITAL VALUE OF THE FOREST.

1. Estimate of the Capital value of the forest	365	73

PART II.

Future Management Discussed and Prescribed.

CHAPTER I.—BASIS OF PROPOSALS.

Sections.	PARA.	PAGE
1. General objects of management	367	73
2. Means of attaining the objects of management	369	74
3. Permanent division of the area	376	75
4. Working circles, their area and distribution, and reasons for their formation	378	76

CHAPTER II.—WORKING PLAN FOR THE CLEAR-FELLING WORKING CIRCLE.

Sections.	PARA.	PAGE
1. General constitution of the working circle and characters of vegetation	383	77
2. Permanent division of the area	388	78
3. Temporary division of the area	390	78
4. Analysis and valuation of the crop	396	78
5. Method of treatment	398	79
6. Method of executing the fellings	423	81
7. Subsidiary sylvicultural regulations in clear-felling area—preparation of the area	440	83
8. Seed collection and nursery works	447	84
9. Formation of plantations	473	89
10. Miscellaneous regulations	504	94
11. Control	513	95
12. Tabular statement of operations	523	97

CHAPTER III.—WORKING PLAN FOR THE SELECTION WORKING CIRCLE.

Sections.	PARA.	PAGE
1. General constitution of the working circle and character of the vegetation	526	99
2. Permanent division of the area	529	99
3. Temporary division of the area	531	99
4. Analysis and valuation of the crop	537	100
5. Method of treatment (Mount Stuart Felling Series)	541	101
6. Method of executing the fellings (Mount Stuart Felling Series)	555	104
7. Subsidiary sylvicultural operations (Mount Stuart Felling Series)	559	104
8. Ulandi felling series—method of treatment	578	107
9. Subsidiary sylvicultural operations	593	108
10. Control	599	109
11. Tabular statement of fellings, Mount Stuart Felling Series, Selection Working Circle	600	110

CHAPTER IV.—WORKING PLAN FOR THE KARIAN SHOLA WORKING CIRCLE.

Sections.	PARA.	PAGE
1. General constitution and character of the vegetation	601	111
2. Permanent division of the area	604	111
3. Temporary division of the area	606	111
4. Analysis and valuation of the crop	610	112
5. Method of treatment	611	112
6. Method of executing the fellings	621	113
7. Subsidiary sylvicultural regulations, seed collection and nursery work	627	114
8. Regeneration of felled areas	634	115
9. Control	647	117

CHAPTER V.—WORKING PLAN FOR THE BAMBOO WORKING CIRCLE.

Sections.	PARA.	PAGE
1. General constitution	651	118
2. Method of treatment	653	118
3. Method of executing the fellings	654	118
4. Control	657	119

CHAPTER VI.—WORKING PLAN FOR THE MINOR PRODUCE WORKING CIRCLE.

Sections. PARA. PAGE
1. Working plan for the Minor Produce Working Circle 658 119

CHAPTER VII.—MISCELLANEOUS REGULATIONS (PRESCRIBED AND SUGGESTED).

1. Safeguards against overproduction 662 119
2. Roads 666 120
3. Maintenance of existing roads 673 122
4. Other communications 674 122
5. Buildings 676 122
6. Maintenance of boundaries 678 122
7. Fire-protection 680 123
8. Livestock 701 128
9. Collection of statistics 704 128
10. Recommendations of the Royal Agricultural Commission .. 707 129
11. Anti-malarial measures 710 129
12. Control 718 131

CHAPTER VIII.—ESTABLISHMENT AND LABOUR.

1. Establishment for Tunacadavu range 731 134
2. Do. Ulandi range 739 136
3. Labour 740 136

CHAPTER IX.—FINANCIAL FORECAST AND COST OF PLAN.

1. Financial forecast 743 137
2. Cost of the working plan 750 140

CHAPTER X.—SUMMARY OF PRESCRIPTIONS. 140

APPENDICES.

APPENDIX A.

Analysis of the growing stock over 3 feet in girth by compartments in all working circles in the deciduous forest 151

APPENDIX B.

List of tree species found in the deciduous forest in the woking plan area 156

APPENDIX C.

List of the identified tree species in Karian Shola 156

APPENDIX D.

Sample Control forms—

(1) Control Book—Clear-felling Working Circle 158
(2) Control Book—Selection Felling Working Circle 169
(3) Control Book—Bamboo Working Circle 160
(4) Control Book—Minor Produce Working Circle 160
(5) Record of Works—Clear-felling Working Circle 161
(6) Record of Works—Miscellaneous 163
(7) Annual Summary of Revenue 164
(8) Annual Summary of Expenditure 164
(9) Nursery Ledger 165
(10) Regeneration Ledger for Clear-felling Working Circle 166
(11) Regeneration Ledger for Gap Regeneration (Selection Felling Working Circle and Karian Shola Working Circle) 167

APPENDIX E.

Sample form for Compartment History 168

APPENDIX F.

PAGE

Provisional volume tables for teak, *Terminalia tomentosa*, *Terminalia paniculata*, *Dalbergia latifolia*, *Lagerstrœmia lanceolata*, *Grewia tiliæfolia and Pterocarpus marsupium* in mixed deciduous forest at Mount Stuart 170

APPENDIX G.

Maps—
- (i) Management map—scale 2 inches = 1 mile (published with the working plan) .. ..
- (ii) Stock map—scale 2 inches = 1 mile (published with the working plan) ..

See pocket in cover.

- (iii) General administration map—
  - (*a*) Scale 12 inches = 1 mile, nine sheets .. ..
  - (*b*) Scale 4 inches = 1 mile, one sheet .. ..
  - (Not published along with the working plan.)
- (iv) Combined " suitability " and " cover " map—(scale 12 inches = 1 mile) showing volumes of timber on every 1½-acre rectangle, and areas suitable for planting with teak. (Not published along with the working plan) .. ..
- (v) Stock maps—(12 inches = 1 mile scale) to be cut up and pasted into the Compartment History by compartments .. ..

Not printed.

REVISED WORKING PLAN FOR THE MOUNT STUART FORESTS

PART I.

Summary of the facts on which the proposals are based.

CHAPTER I.—THE TRACT DEALT WITH.

SECTION 1.—NAME AND SITUATION.

1. *General.*—The area covered by the working plan consists of the whole of the Tunacadavu range as at present constituted, with the exception of the portion of the Tekkadi leased forest called the Keerapadi block, which lies west of the Malabar boundary between Pandaravaraimalai and Kuchimalai, and north-east of the ridge joining Pandaravaraimalai and Ayyasamimudi. This portion, although belonging to Tunacadavu range, is administered by Pollachi range, as it consists of part of the Gudaravalli Fuel series of that range. The working plan area lies entirely within the Tunacadavu reserved forest, and covers the greater part of it.

A small additional strip belonging to Punachi range, and lying between the range boundary and the Panatti Ar, and continuing southwards with a portion of the Periyar as its eastern boundary (as marked on the Management Map), is included in the working plan area.

2. *Position.*—The tract lies between north latitude 10° 21′ 00″ and 10° 31′ 00″ and between longitudes 76° 44′ 30″ and 76° 53′ 30″ east of Greenwich. It is situated at the western end of the Anamalai Hills partly in Coimbatore district and partly in Malabar, and borders on Cochin State on the south-west.

3. *Boundaries.*—The boundaries of the working plan area are as follows :—

North.—From the Tekkadi river at Tekkadi village along the demarcated boundary line of the Tekkadi leased forest via Poliandanparai to Chengalpadi kanavoi at the foot of the Tekkadi timberslide. There the working plan boundary leaves the demarcated boundary of the leased forest and turns first south, and then south-east along the watershed and ridge of hills via Ayyasamimudi (△ 2753) and Kathadimudi (△ 2696) to Pandaravaraimalai △ 4236. (See Madras Forest Survey map, 4 inches=1 mile.)

East.—From Pandaravaraimalai the boundary proceeds eastwards for a short distance as far as the edge of the precipice and then turns southwards following the old cleared fire-line through △ 3056, and 2465, crossing the Top Slip ghaut road near the 14th mile 6th furlong, and passing through △ 3613 to Kolambumalai (△ 3706). Thence it goes in a straight line to point 3843, and turns east to point 4433 and thence in a south-westerly direction, via point 3863 to Umayamalai (△ 4095). From Umayamalai it runs southwards to the point where the Murungali Ar meets the Varigali Ar on its right bank. From that point it leaves the range boundary, and turns eastwards up the Varigali Ar to point 2003 app, where it turns S. 30° E, crossing the saddle, from which it turns due south and follows the stream till it meets the Panatti Ar, and continues south to where latter joins the Periyar. The boundary then follows up Periyar due south as far as the corner, where it leaves the river and continues in a south-easterly direction for about 26 chains till it meets the Tumen Kundru ridge. The boundary then runs up the ridge, in a south-westerly direction, past Tumen Kundru (△ 3584) until it again meets the range boundary, which it follows in a southerly direction until it meets the northern boundary of the recently disreserved tea estates.

South.—The boundary follows the northern edge of the disreserved tea estates until it meets the Cochin boundary. On account of some new applications for land for tea, this portion of the boundary is not definite at the moment. The Survey department is now engaged in surveying the new applications recently sanctioned by Government and the question of a revised range boundary will be finally settled when the estate boundaries have been defined by the Survey department.

West.—The boundary follows the demarcated Cochin State boundary northwards via Palakadavu and Shekalmudi to Vengolimalai, whence it runs westward along the ridge through Periavaraimalai, Tottivaraimalai and Pothumukkanmudi to Pulalimudi, from which it turns north-north-west to the point where the Tunacadavu Ar meets the Itti Ar. The boundary then follows the Itti Ar and Tekkadi Ar up to Tekkadi village.

SECTION 2.—CONFIGURATION OF THE GROUND.

4. (*a*) *Mount Stuart Block, and Tekkadi Leased Forest.*—This forest is bounded on the south by a steep rocky ridge precipitous in parts, running east and west from Umayamalai (4,095 feet) through Vengolimalai (3,697 feet) to the south-west corner of the forest. The upper portions of this ridge are too rocky, and steep to be workable. In the north-east of the forest there is a group of precipitous hills which for the same reason cannot be worked. For the rest, the forest consists of low undulating hills, much broken up by ravines and nullahs. As a general rule the northern or north-western slopes of the ridges are steepest. The general slope of the country is down from the north-east to the south-west.

(*b*) *Ulandi block.*—The Ulandi block consists of a deep basin drained by the Vaigali Ar and its tributaries, and surrounded by high steep ridges of hills. The country is much broken up by steep sided valleys. The general slope is down to the south-west where the Varigali Ar enters Cochin State through a narrow valley. The configuration of the ground is such that the only easy and natural outlet for timber is down the Varigali valley into Cochin State.

(*c*) *Palakadavu block.*—This consists of a wide valley, separated from the Ulandi block on its north side by the steep rocky Nadumalai ridge. The country is very steep and broken on the north of the Periyar river, but on the south side the country slopes gently up from the river in an undulating and much broken plateau to the foot of the steep slopes of Palagankundru. This block is even more inaccessible than the Ulandi block, and the natural outlet for timber is down the Periyar valley into Cochin State.

Both the Ulandi and Palakadavu blocks have not been regularly worked hitherto on account of their inaccessibility.

SECTION 3.—GEOLOGY, ROCK AND SOIL.

5. The underlying rock is gneiss, which on disintegration forms a rich sandy loam upon which teak thrives. The soil is deep over large areas, but shallow in parts. The top layer is black in colour and richly impregnated with humus, whereas the subsoil is reddish in colour, and varies from a very sandy loam to almost pure clay. The drainage is for the most part good, though there are a few flat swampy places in the bottoms of the valleys which are unsuitable for teak. Some areas to the west of Peruvarikulam and others near the Itti Ar consist of disintegrated laterite upon which *Xylia xylocarpa* flourishes and is in places almost pure. Teak does not thrive well on these laterite areas.

SECTION 4.—CLIMATE.

6. *General.*—The climate is temperate, with neither great extremes of heat nor of cold.

7. *Temperature.*—The extremes of shade temperature vary approximately between 60° and 105° Farenheit. The hot weather is short, lasting from the middle of February to June, and is not severe as compared with other districts less favourably situated.

8. *Rainfall.*—The rainfall averages about 63 inches per annum at Mount Stuart and is fairly well distributed throughout the year. Close to the Vengolimalai ridge and in the forests west of Sungam the rainfall appears to be greater than at Mount Stuart, and it seems to increase as one goes further south. Thus the Ulandi valley and Palakadavu valley have a higher rainfall than Mount Stuart. The rainfall figures for the last three years have been taken at Top Slip, and seem to indicate that less rain falls there than at Mount Stuart. The rainfall in the vicinity of Tekkadi is unknown, but is probably about the same as at Top Slip.

9. *Distribution of rainfall.*—The bulk of the rain falls in the south-west monsoon between June and August. September has a comparatively low rainfall, but fairly heavy rain usually falls in the north-east monsoon in October and November. This rain is however not so continuous as in the south-west monsoon. The latter half of January, February and March are dry months with very little rain. Occasional thunderstorms occur in April and May which cause some of the teak sown in April to germinate before the monsoon. A tabulated statement of the rainfall since July 1917 is given below.

RAINFALL STATEMENT FOR TUNACADAVU RANGE.

Months.	1917.	1918.	1919.	1920.	1921.	1922.	1923.	1924.	1925.	1926.	1927.	1928.	1929.	Average.
January	..	2·60	1·60	Nil.	3·40	3·55	4·80	1·25	2·55	0·71	Nil	Nil.	0·40	1·73
February	..	Nil.	Nil.	Nil.	Nil.	1·00	Nil.	Nil.	0·67	Nil.	Nil.	5·12	Nil.	0·56
March	..	2·20	2·80	1·00	0·23	Nil.	1·25	Nil.	2·23	0·10	0·60	1·60	Nil.	1·00
April	..	Nil.	5·60	3·80	6·95	1·45	2·40	5·58	5·00	0·70	1·90	2·30	3·20	3·24
May	..	12·00	2·00	5·00	0·22	2·85	0·91	4·15	4·25	3·63	2·50	2·10	3·50	3·59
June	..	5·20	11·00	13·36	6·50	7·78	10·10	16·60	11·08	4·85	10·26	9·74	15·00	10·12
July	4·00	2·60	11·10	19·10	12·97	18·00	25·08	37·60	9·23	16·70	16·53	6·00	12·35	14·71
August	2·80	5·60	9·60	2·80	16·80	5·13	21·25	9·58	8·43	10·35	2·50	10·62	4·20	8·44
September	12·40	0·40	4·40	2·00	2·23	3·18	1·95	4·20	2·60	4·15	3·00	0·32	3·71	3·43
October	2·40	4·80	6·00	4·40	8·23	13·95	2·80	7·43	4·85	0·80	5·55	3·61	6·85	5·51
November	5·20	7·60	9·00	16·25	2·70	8·95	0·60	8·30	9·30	3·15	3·00	4·95	7·56	6·66
December	2·90	0·30	10·56	Nil.	6·20	2·85	5·98	1·30	8·93	1·30	Nil.	2·55	Nil.	3·29
Total ..	29·70	43·30	73·66	67·71	66·43	68·69	77·12	95·99	69·12	46·44	45·84	48·91	56·77	62·28

A rain-gauge has recently been installed at Anaipadi, and it will be interesting to compare the rainfall there with that at Top Slip.

10. *Storms.*—Severe storms and high winds are rare and seldom do much damage to the forest.

11. *Healthiness.*—During the months of December to June malaria is prevalent, March, April and May being the worst months. Formerly, on account of the very high incidence of sickness during these months, all work in the range was stopped, and the whole staff retired to the plains until the monsoon broke. From June to the end of November the climate is pleasant and comparatively healthy.

12. The old range headquarters at Mount Stuart were so malarial that in 1927 they were moved to Top Slip which has proved to be both cooler and healthier on account of its exposed position and the almost continual wind that blows there. Anti-malarial clearings have been made round the buildings, the bottoms of the neighbouring streams have been paved with stone, and disciplinary measures are taken to see that no standing water is allowed anywhere in the vicinity of the buildings. In spite of these precautions Top Slip is still malarial in the hot weather. A further improvement might perhaps be made by making the quarters of the permanent subordinates and the rest-house mosquito-proof, with spring mosquito-proof doors, and by insisting that all subordinates are in their quarters by sundown in the fever season, and that they keep the mosquito-proof doors properly shut all night.

SECTION 5.—WATER-SUPPLY.

13. At Top Slip there is a plentiful supply of good water all the year round from the reservoir built in Karian Shola in 1927. All the quarters and the

forest bungalow have the water laid on in pipes. There is also a good perennial spring which has been walled and covered in, situated below the Anaipadi road in the bend just below Top Slip. There are two other springs at Top slip, one below the rangers' quarters on the western side, and the other between the assistant ranger's quarters and the Range Office, a short distance down the slope to the north-west.

14. At Anaipadi the Tunacadavu river and its tributary which comes from Karian Shola provide the water-supply, but considerable difficulty is experienced in March and April in dry years, when both these rivers dry up, leaving only small stagnant pools.

15. At Sungam, where the new elephant camp is to be situated, the Tunacadavu river will be the only water-supply. It usually ceases to flow and dries up leaving only a few stagnant pools in March.

16. The water for Mount Stuart was formerly supplied by a hydraulic ram which pumped water up from the Tunacadavu river. When the range headquarters were moved to Top Slip the ram broke down, and the channel leading the water from the dam above " Waterfall " to the ram fell into disrepair. The only present water-supply for Mount Stuart is from a spring to the north of the rest-house, or from the stream between the old tram-line and Mount Stuart. Both these dry up in the hot weather. The Mount Stuart bungalow can therefore only be occupied between June and January.

17. At Tekkadi there is a perennial stream behind the old ranger's quarters which gives a small, but unfailing, supply of good water all through the hot weather.

18. Other springs which give a supply of water most of the year are found at Peruvarikulam (brackish), and near the twentieth mile on the Anaipadi road, about 100 yards to the west of the corner of the road. Small springs are also found below the " Fitters' quarters " at Mount Stuart on the eastern side, one below, and one almost on the old bridle-path to Mount Stuart bungalow, but these dry out at the beginning of the hot weather.

19. As mentioned above, all the rivers stop flowing in February in a normal year, and the water-supply is not sufficient for the working elephants after the end of January. It is therefore necessary to send all the elephants away from Mount Stuart at the end of January until the end of the hot weather. This enforced inactivity puts up the cost of dragging considerably.

20. In Ulandi, the Vanigali Ar flows all the year round except in unusually dry seasons. The Minmadu Ar, and the stream which comes from Vengolimalai and crosses the Perambikulam path about a mile before it reaches the Cochin boundary are said to flow all the year round. This has, however, not been verified. There is always a plentiful flow of water in the Periyar at Palakadavu which is, on this account, a favourite hot weather camp for the elephants.

SECTION 6.—DISTRIBUTION AND AREA.

21. The working plan area consists of—

(*a*) the Tekkadi leased forests and

(*b*) most of the balance of the Tunacadavu reserve lying in the Coimbatore district.

22. The Tekkadi leased forest contains 17,414 acres (of which 16,593 acres come within the working plan area), and the balance of the Tunacadavu reserve contains 31,598 acres, of which approximately 18,440 acres come within the working plan area. This latter portion is divided into three contiguous blocks, by parallel ranges of hills, namely, the Mount Stuart block, the Ulandi block and the Palacadavu block.

23. Of the total area of 49,012 acres, 35,033 acres will be dealt with under this plan.

SECTION 7.—STATE OF THE BOUNDARIES.

24. The boundary between British forests and Cochin State forests consists of a cleared line demarcated by stones with an arrow mark on the Cochin side. The boundary between British forests and the Tekkadi leased forest consists of a cleared line marked with cairns at intervals. This line is distinct through Karian Shola and is visible in parts of the forest between Mount Stuart and Vengolimalai, but in other parts it is not traceable. The boundary between the Tekkadi leased forest and Cochin State forests consists of a cleared line along the ridge running westward from Vengolimalai until it meets the Itti Ar at its junction with the Tunacadavu Ar. The remainder of the western boundary of the Tekkadi leased forest consists of the Itti and Tekkadi rivers, up as far as Tekkadi village when it turns eastward and is demarcated by a line of stones, some of which appear to be missing. The eastern boundary of the Tunacadavu range is not demarcated where it follows natural features. Between Kolambumalai and the end of the ridge running up north-north-west from Tannipallam the boundary is marked by a cleared line which was formerly a fire-line, but which is not now maintained.

SECTION 8.—LEGAL POSITION.

25. The whole of the area under consideration is included in the Tunacadavu reserved forest notified as such in G.O. No. 1472, Revenue, dated 27th September 1883. A portion of this area is leased from the Raja of Kollengod for an annual rental of Rs. 5,000, and is called the Tekkadi leased forest. For the conditions of this lease, vide the lease deed and paragraphs 188 to 190 infra. There has been no alteration in the terms of the lease since 1887, with the exception that an agreement for capturing elephants within the leased forest was entered into in 1921, and revised in 1929 as described below. Apart from this no new rights and concessions have been admitted nor old rights cancelled during the period of Mr. Wood's working plan.

SECTION 9.—RIGHTS AND CONCESSIONS.

26. The following are the rights of way in Tunacadavu reserve :—

(1) *Right of way from Tellikal to Tekkadi, and thence to the Gudaravalli forest in Coimbatore district.*—This route consists of four sections, viz., (*a*) route from Tellikal to Kachithodu in the Kollengod Raja's Forests, which is only a foot-path and is now not traceable for a great part of its length. The length of that portion of this section lying within the Tekkadi leased forest is about 2 miles.

(*b*) In continuation of the above the route from Kachithodu to Pazhayamudi is a cart-track, now disused, running in a north-easterly direction along Kalyanakodal Puvankadavu, Mangajam and Puliandamparai as shown in the map. The length of the portion of the cart-track lying within the Tekkadi leased forest is about 4 miles.

(*c*) The route from Pazhayamudi to Adivaram is a timber slide as shown in the map. The length of the slide is about 2 furlongs.

(*d*) From the bottom of the slip a cart-track runs to Adivaram in a south-easterly direction for about 2 miles, and leaving the Tekkadi leased forest it runs through the Gudaravalli forest in British territory in an easterly direction as far as the reserve boundary which it meets at about cairn 80. The length of the cart-track from the district boundary to the reserve boundary is about 3 miles. The width of the whole right of way is 30 feet.

(2) *Right of way from Tellikal to Pillakalparai in Tekkadi leased forest.*—The path runs from Tellikal in a south-easterly direction as far as Pillakalparai crossing the Tunacadavu river *en route*. The length of the path is about $2\frac{1}{2}$ miles and the width 30 feet.

NOTE.—The Nambidis and Government Kadirs have the sole right of way over the path—B.P. No. 543, dated 22nd April 1880.

(3) *Right of way from Tunacadavu (Mount Stuart) to the Cochin territory via the Anagundi Pass.*—The path runs from Mount Stuart in a southerly direction via the Anagundi pass, and leaves the Coimbatore-Cochin boundary at about 1½ miles south-east of Vengoli peak.

NOTE.—The Nambidis and Government Kadirs have the sole right of way over the path—B.P. No. 543, dated 22nd April 1880.

(4) *Right to collect minor produce in the British portion of Tunacadavu reserve.*—No claims to collect, or share in the value of the minor forest produce from the Government reserve have been advanced or admitted, except by the Kadirs, whose privileges in this respect have never been gainsaid. It will, however, be necessary to take steps to prevent them from collecting minor produce from within the working plan area in future, so as to eliminate one of the most dangerous sources of forest fires.

27. For further rights and concessions, vide the conditions of the lease deed entered into on 2nd May 1887 between the Nambidis of Kollengod and the Government.

CHAPTER II.—THE FOREST.

SECTION 1.—COMPOSITION AND CONDITION OF THE CROP.

28. *Types of forest.*—The forest growth within the working plan area consists of three chief types, namely, teak plantations, mixed deciduous forest, and evergreen forest. These types are sharply defined for the most part, though there are a few places where the mixed deciduous forests tends to merge into the evergreen type and is probably in a state of transition. There appears to be very little doubt that where the forest has escaped fires, the evergreen type tends to spread, and that where fires are frequent the evergreen tends to recede, turning into deciduous forest.

A. Teak Plantations.

29. *General.*—The teak plantations have been formed in selected areas of the better quality mixed deciduous forest. Apart from a few older experimental areas, namely the " Waterfall Plantation " of 1872–73 of which about 5 acres survive, and the narrow strip of plantation on the north-west side of the tram-line, which is supposed to be the remnant of the old " Karian Shola " plantation of 1874, all the plantations are of recent formation. Teak planting as a regular measure was started under Mr. Wood's working plan in 1919 as a result of the success of Mr. Wood's original experimental plantation of 5 acres made in 1916 at Mount Stuart. Regular planting was started on a small scale, only 28 acres being attempted in 1919, working up to a maximum area of 261 acres in 1926. It was found however that this area was too large for convenient working, and that owing to the difficulty of getting sufficient labour to do the work in time, and of supervising the work closely enough, the cost of the plantations became unnecessarily high. The following are the areas planted up to date, according to the figures furnished by the District Forest Officer :—

Year.	ACS.	Year.	ACS.
1916	5	1926	261
1919	28	1927	155
1920	8 (failure).	1928	144
1921	29	1929	151
1922	126	1930	224
1923	193		
1924	226	Total ..	1,801
1925	251		

It will be seen therefore that the age classes will not be quite evenly distributed, though at maturity there will be so little difference between the size of the 1919 plantation and the 1924 plantation that it will be possible to adjust the fellings so as to give an almost uniform yield.

30. *Species planted.*—The plantations previous to 1926 were all of pure teak, with the exception that the failed area of 1920 was subsequently planted with *Dalbergia latifolia, Terminalia tomentosa,* and *Terminalia paniculata.* In the plantations from 1922 onwards a few small swampy areas have been planted with *Terminalia tomentosa.*

In 1926, 1927 and 1928 alternate strips of teak and *Dalbergia latifolia* were planted as an experimental measure, in an attempt to prevent, or at any rate to diminish the dangers that so frequently attend pure crops. In the 1926 plantation the alternate strips of *Dalbergia latifolia* and teak were of different widths varying from one row of each to thirty rows of each. In the 1927 and 1928 plantations the widths of the strips were five and fifteen rows of each respectively. It is too early to say yet whether the experiment is likely to be a success, but owing to the large numbers of casualties in the *Dalbergia latifolia* strips, and to the very slow growth of that species, a dense mass of weeds and creepers covered them and invaded the teak, necessitating expensive cleanings in the second and the third years of the plantation. It is probable that if the *Dalbergia latifolia* does not overtake the teak within ten or twelve years, the trees on the outside of the teak strips will become badly forked and have lop-sided crowns. For these reasons the experiment was not continued after 1928, and pure teak plantations were again reverted to in 1929, with the exception of an area of 30 acres in which teak and *Dalbergia latifolia* were sown at the same stake. The results appeared to be so satisfactory that, in 1930, the whole of the area was treated in this way. *Pterocarpus marsupium* was sown in alternate strips with teak in about 5 acres of the 1928 plantation.

31. *Stocking.*—The original espacement of the plantations is 4½ feet by 4½ feet. The stocking is however very variable, being usually good on the best quality areas and very open on the poor quality areas, or on areas otherwise not properly suited to teak. This indicates that great care must be taken to select areas that are undoubtedly suitable for teak, and are at the same time of good quality of locality. Portions of the plantations of 1922 and 1926 are sad examples of the result of planting on unsuitable areas.

32. *Choice of suitable areas for planting teak.*—While preparing the present working plan, areas that are undoubtedly suitable for clear-felling and planting with teak have been selected and marked on the map. The following factors have been taken as indicating areas definitely unsuitable for planting :—

(*a*) Poor height growth.

(*b*) Rocky conditions.

(*c*) Swampy conditions.

(*d*) Presence of much *Anogeissus latifolia, Pterocarpus marsupium, Bauhinia racemosa, Acacia leucophlœa, Careya arborea, Garuga pinnata, Hymenodictyon excelsum, Cycads,* small poorly grown bamboos, etc., all indicating a poor quality soil.

(*e*) Presence of almost pure *Xylia xylocarpa* indicating an insufficiently disintegrated laterite soil.

(*f*) Presence of *Randia dumetorum, Randia uliginosa, Butea frondosa, Zizyphus xylopyrus, Macaranga species, Lagerstrœmia Flos-Reginae,* coarse " Elephant grass " (*Imperata arundinacea*), and abundant *Terminalia tomentosa* of poor quality all indicate swampy or insufficiently well-drained localities.

33. The following factors indicate localities suitable for teak :—

(*a*) Presence of good teak growth, and of large stumps of felled trees.

(*b*) Good height growth.

(*c*) Large-sized, tall healthy bamboos.

(*d*) A limited number of species, of which *Terminalia tomentosa, Terminalia paniculata, Lagerstrœmia lanceolata, Grewia tiliaefolia and Dalbergia latifolia* are the chief. (Areas in which a very large variety of species are found are usually of poor quality.)

The areas selected must be well drained and of good quality as indicated by the height growth of the forest. In some places, notably in Ulandi block, there are extensive areas which fulfil the above conditions and are apparently of excellent quality except that not a single natural teak tree is found, and it is possible that there is some edaphic factor which is not suitable for the growth of teak. This point requires investigation. It has recently been noticed that teak requires a certain very small amount of lime in the soil, and possibly lack of lime may be the cause of the absence of teak on these areas. On the other hand, these areas may prove to be quite suitable for planting teak, though if that is the case it is difficult to account for its complete absence.

34. *Appearance of other species naturally in the plantations.*—Previous to 1928, it was the custom when weeding, cleaning or thinning to remove all other species which came into the plantations naturally, either from coppice stools or from seed, with the result that in the older plantations there are very few trees of other species mixed with the teak. A more enlightened policy has however been followed since 1928, with the result that there is a considerable admixture of subsidiary species in the later plantations. The principal species to be noted as occurring in mixture with the teak are *Dalbergia latifolia, Lagerstrœmia lanceolata, Grewia tiliaefolia, Xylia xylocarpa, Terminalia tomentosa, Terminalia paniculata* and the bamboo, *Bambusa arundinacea.*

Dalbergia latifolia occurs sporadically in all the plantations, coming in naturally under the teak. It appears to flourish under a dense canopy, and looks more healthy than in the open. Slow of growth to start with, it later, in the sapling stage, rapidly pushes its crown up to the top canopy. Being a small crowned tree it does not suppress the surrounding teak. It would, indeed, be an ideal tree for a mixture were it not for the fact that it sheds its leaves at the same time as the teak, and therefore does not afford that shelter for the soil that is desirable.

Lagerstroemia lanceolata frequently comes into young plantations in large quantities. It is, in its sapling stage, a faster growing tree than teak and having a spreading crown, soon suppresses the teak all round it, becoming a ' wolf tree '. Where it is doing damage in this way, it has to be removed in the thinnings.

Grewia tiliaefolia also comes into the young plantations in large quantities especially on the poorer quality localities and is even a worse 'wolf ' than *Lagerstrœmia lanceolata,* and has to be cut out in the thinnings.

These two species may with advantage in suitable cases be pollarded, thus retaining the mixture and cover for the soil.

Xylia xylocarpa.—In all areas where the soil has a trace of laterite in it, natural Xylia regeneration is plentiful in the teak plantations. It makes a good mixture with the teak in its young stage but tends to suppress it in older plantations in a laterite area.

Terminalia tomentosa occurs naturally in the plantations in small quantities. It is slow in growth to start with and tends to become suppressed. It does well in slightly swampy localities.

Terminalia paniculata occurs naturally in the plantations but never in large quantities, and becomes suppressed unless there is a gap in the canopy to let in sufficient light for its growth. It grows very slowly to start with.

Adina cordifolia.—Small seedlings of Adina cordifolia are frequently found in well burnt patches of the regeneration area in the first year but they seldom come to anything, being very delicate.

Stephegyne parvifolia.—In the first year of a plantation *Stephegyne parvifolia* regeneration is frequently very abundant, but like *Adina,* it scarcely ever survives.

Bambusa arundinacea.—Bamboos occur naturally in almost every plantation, becoming apparent as a switchy growth in the second year. If left they rapidly form clumps which suppress the teak all round, and they have to be cut out as soon as seen. It is stated that bamboo is killed if it is cut over three times. This switchy growth probably comes from young clumps which have not been killed by the burn. It is not yet known whether, in areas where the bamboos have flowered, the young bamboo seedling regeneration will prove so troublesome as to make the formation of plantations in such areas very expensive, or even impossible.

35. *Undergrowth.*—In the best stocked areas the undergrowth is scanty, consisting of low weeds and short grass. When the canopy is at all open, dense masses of Lantana, *Acacia pennata,* and other creepers are found. The undergrowth is of a deciduous type and does not protect the soil to any extent in the hot weather, and moreover becomes highly inflammable.

36. *Underwoods.*—The question of underwoods is one of importance, and the necessity for discovering the best method of introducing them must constantly be borne in mind. There are at present no natural underwoods in the teak plantations and all attempts to grow them have, so far, failed. It has been stated that a pure crop of teak will cause serious deterioration of the soil, though this does not appear to have been definitely proved. At Nilambur the second rotation crops, once they have been established, appear to be growing almost as well as the original crops, as far as is known. The purpose of an underwood is partly to prevent such deterioration by supplying mixed humus from fallen leaves. This however can be achieved to a certain extent by obtaining a suitable mixture in the main crop, or by favouring subsidiary species at the time of thinning. Another important function of an underwood in pure teak plantations is to provide sufficient material to produce a good burn at the time of felling the crop and regenerating the area. The chief difficulty experienced at Nilambur in regenerating second rotation crops was due to lack of sufficient material for a good burn. It is probable however that this difficulty can be overcome by soil aeration.

37. No regular planting of underwoods is being prescribed in this plan. Attempts to produce underwoods are being made at Nilambur under the present Nilambur Working Plan, and if these attempts are successful and indicate a method by which suitable underwoods can be raised both successfully and cheaply the method may be tried experimentally at Mount Stuart, and prescribed later if successful. Up to date, the most suitable species for underplanting appears to be Mahogany (*Swietenia macrophylla*), but with all species tried the expenses is considerable, and is indeed so great that, at present, underplanting is not justified.

B. The Mixed Deciduous Forest.

38. *General.*—As has been described in the chapter on the past history of the forest, the deciduous forests have been worked very heavily in the past, and large quantities of teak timber have been removed without any effective attempts at regeneration. There is very little doubt that the forests have greatly degenerated and that in the past the proportion of teak was considerably greater than it is now. This is to be expected, since the inferior species have been left to regenerate themselves in place of the teak which has been removed.

39. *Chief species.*—The forest is of a mixed deciduous type with large quantities of bamboo (*Bambusa arundinacea*) scattered throughout it. The chief species are *Tectona grandis* (Teak), *Dalbergia latifolia* (Rosewood), *Terminalia tomentosa* (Karumarudu), *Terminalia paniculata* (Pillamarudu), *Lagerstrœmia lanceolata* (Venteak), *Pterocarpus marsupium* (Vengai), *Grewia tiliæfolia* (Thadasu), *Adina cordifolia* (Manjakadambai), *Stephegyne parvifolia* (Nirkadambai), *Xylia xylocarpa* (Irul), *Albizzia odoratissima* (Karuvagai), *Schleichera trijuga* (Poovathi) *Stereosperumum xylocarpum* (Vedangurnai), *Stereospermum chelenoides* (Poopathiri), *Anogeissus latifolia* (Naval), and *Dillenia pentagyna* (Punna). The total number of different tree species found in the purely deciduous forest is 78, a list of which is given in Appendix B.

40. *Sub-types.*—Five fairly distinct sub-types may be distinguished in the mixed deciduous forest, namely, (1) the type on deep soil with good quality of locality, (2) the type on shallow soil and poor quality of locality, (3) the *Xylia* type, (4) the rocky type, and (5) the swamp type.

41. *Sub-type* (1).—The type on good quality localities is characterized by having a limited number of species, good height growth, and a large proportion of bamboos of big size. The chief species are teak, *Dalbergia latifolia, Lagerstrœmia lanceolata, Grewia tiliæfolia, Terminalia paniculata, Terminalia tomentosa Schleichera trijuga, Dillenia pentagyna* and occasional trees of *Adina cordifolia, Stephegyne parvifolia,* and *Albizzia odoratissima* and very little else. The undergrowth is usually scanty where the canopy is dense, and consists of various species of *Desmodium* and herbaceous weeds with a little grass. This type is the most suitable for clear-felling and planting with teak.

42. *Sub-type* (2).—The poor locality type is characterized by a great variety of species, almost all of the species on the list (Appendix B) being found. The chief species are *Anogeissus latifolia, Albizzia odoratissima, Grewia tiliæfolia, Stereospermum spp., Terminalia paniculata, Terminalia tomentosa, Pterocarpus marsupium, Phyllanthus emblica,* and *Garuga pinnata.* The undergrowth is typically grassy though dense masses of Lantana, and *Cæsalpinia* are frequently found. Cycad palms are characteristic of this type. Bamboos occur, but are not so numerous nor so large as in the good quality localities.

43. *Sub-type* (3).—The Xylia type is found on laterite soils, and in its extreme form consists of almost pure *Xylia xylocarpa* with no bamboos, and very few other species. It gradually merges into either of the above two types. Such pure *Xylia* localities are usually unsuitable for growing teak, though good quality areas [sub-type (1)] do often contain a large proportion of *Xylia* and at the same time grow first-class teak.

44. *Sub-type* (4).—The rocky type is characterized by being open, with occasional small trees of *Givotia rottleriformis, Sterculia villosa, Bombax insigne,* and *Cochlospermum gossypium.* The undergrowth is typically tall coarse grass, in between the slabs of rock and boulders. This type merges into type (2) above, stunted *Pterocarpus marsupium,* and Terminalia species appearing first.

45. *Sub-type* (5).—The swamp type consists of open grassy areas with occasional trees of *Butea frondosa, Randia uliginosa, Zizyphus xylopyrus* and small trees of *Terminalia tomentosa.* In merging into type (1) above, very fine *Terminalia tomentosa* is frequently found.

46. *Distribution of sub-types.*—About half of the forest consists of sub-type (1), and a large portion of the remainder is intermediate between sub-types (1) and (2). The area in the Mount Stuart and Tekkadi blocks considered suitable for clear-felling and planting is 8,689 acres, and the area to be worked under selection fellings is 7,249 acres.

47. *Distribution of the age classes.*—The following extract from the enumeration figures shows the distribution of the numbers of trees over the different girth classes.

Abstract of Enumeration.

Mount Stuart.

Species	Callipered minimum girth breast height classes.*												Totals.	
	3′ to 4′.		4′ to 5′.		5′ to 6′.		6′ to 7′.		7′ to 8′.		8′ and over.			
	Corresponding mean girth breast height classes.													
	3′ 1·7″ to 4′ 3·3″.		4′ 3·3″ to 5′ 4·6″.		5′ 4·6″ to 6′ 6·2″		6′ 6·2″ to 7′ 6·9″.		7′ 6·9″ to 8′ 8·3″.		8′ 8·3″ and over.			
	Number of trees.	Volume.	Number of trees.	Volume.	Number of trees.	Volume.	Number of trees.	Volume.	Number of trees.	Volume.	Number of trees.	Volume.	Number of trees.	Volume.
1	2		3		4		5		6		7		8	
Teak	9,161	159,631	11,039	361,458	10,333	500,650	8,019	542,428	5,658	506,348	3,776	5,48,814	47,986	2,619,329
Rosewood	2,790	43,867	1,993	56,776	1,207	54,899	739	46,874	416	36,718	284	37,963	7,429	277,097
Other saleable species ..	62,179	1,041,079	43,073	1,278,313	24,865	1,118,161	14,561	9,04,754	8,676	712,960	6,100	770,933	159,454	5,826,200
Total ..	74,130	1,244,577	56,105	1,696,547	36,405	1,673,710	23,319	1,494,056	14,750	1,256,026	10,160	1,357,710	214,869	8,722,626

Note.—The average volume of timber per tree is as follows :—
$3'$ to $4\frac{1}{2}'$ in girth, 16·79 c.ft.
$4\frac{1}{2}'$ to $5\frac{1}{2}'$,, 30·24 ,,
$5\frac{1}{2}'$ to $6\frac{1}{2}'$,, 45·98 ,,
$6\frac{1}{2}'$ to $7\frac{1}{2}'$,, 64·07 ,,
$7\frac{1}{2}'$ to $8\frac{1}{2}'$,, 85·15 ,,
$8\frac{1}{2}'$ and over ,, 133·63 ,,
For the girth classes up to $7\frac{1}{2}'$, the volumes are approximately in the ratio of 1 : 2 : 3 : 4.

* Vide Chapter VI, paragraphs 346 and 363.

C. The Evergreen Forests.

48. *General.*—The evergreen forests are found in several compact blocks in the Ulandi and Palakadavu valleys, and in the north-eastern portion of the Mount Stuart block. This latter portion, called Karian Shola, consists of a compact block of 2,060 acres of evergreen forest, and owing to its accessibility, it will be worked under this plan. All the other areas of evergreen forest are too inaccessible to work economically under present conditions.

49. Karian Shola contains a great variety of evergreen tree species, many of which are good timbers. The crop is not homogeneous and varies considerably from place to place. In some areas the growth is very fine, and in others comparatively poor. Some areas contain plentiful *Hopea*; in others *Mesua* is the chief timber, while over large areas there are very few trees of the better quality timbers, *Aglaia Roxburghiana* being the commonest tree. *Calophyllum elatum* (*Tomentosum*) occurs in certain parts of the shola, but is scarely ever found along with *Hopea.* An attempt to divide the shola up into types was not successful owing to the enormous variety of species which appear to be common to most types.

50. *Species.*—The chief species occurring in the shola are *Hopea parviflora* (Irumbogam) *Mesua ferrea* (Suruli), *Aglaia Roxburghiana* (Sembil), *Calophyllum elatum* (Poon), *Dysoxylum malabaricum* (White Cedar, Vellagil), *Eugenia Gardneri*, several other *Eugenia* species, *Bombax malabaricum, Canarium strictum, Polyalthia fragrans, Amoora canarana,* and several other species of the *Meliaceae* not identified, *Myristica attenuata, Diospyros microphylla, Diospyros bourdilloni*, etc. The crop is so variable that in one year's working, the yield may consist of a large proportion of valuable species, and in another year's working the yield may consist almost entirely of second rate species such as *Aglaia* or *Amoora.* There is scarcely any *Dichopsis elliptica* or *Artocarpus hirsuta* in Karian Shola, though both these species are found in moderate quantities in the Ulandi and Palakadavu Sholas. *Acrocarpus fraxinifolius, Cedrela toona* and *Chikrassia tabularis* occur in very small quantities, only an occasional tree being found here and there. A large percentage of the crop consists of small trees of very many species scarcely ever reaching timber size, such as *Cyclostemon macrophyllus, Acronychialaurifolia, Adenochlaena indica,* and *Gomphandra polymorpha,* to mention only four of the most abundant species. A list of species identified in the shola showing whether they belong to the top, second or third stories, or whether they are well-known timber species or not, is given in Appendix C.

51. A rough enumeration of Karian Shola was carried out in 1926 by the subordinates of the Logging Engineering branch, but this is, unfortunately, not very accurate because the enumerators had had little experience of evergreen forest. They were not able to identify the species correctly and frequently enumerated several species under one name. The whole enumeration was done by eye estimate, no measurements being taken.

52. *Natural regeneration.*—Wherever large *Hopea* trees exist, very dense natural regeneration is found, which, unless assisted by letting in a certain amount of light by judicious fellings in the middle storey, remains suppressed for a great number of years.

Mesua ferrea also regenerates itself freely, and the young seedlings seem to be able to develop under fairly dense shade, though it is not known how long they take to do so. Careful opening up, and letting in of light will doubtless assist it to grow more rapidly.

Chickrassia tabularis, when found regenerates itself freely, but, judging from the absence of saplings or advance growth of this species, most of the seedlings seem to perish in the early stages. *Calophyllum elatum* regeneration is scarcely ever found, and the younger age classes of this species are markedly absent. The same remarks apply to *Dysoxylum malabaricum.*

53. *Undergrowth.*—The undergrowth consists chiefly of species of *Strobilanthes* which covers the ground very densely. Attempts made to obtain

natural regeneration by opening the canopy were all frustrated by the dense growth of this weed which immediately took possession of the area. Experiments have shown however that established regeneration continues to exist under it, and that the *Strobilanthes* is easily removed by cutting it to the ground a suitable number of years after it has seeded. Under these circumstances the amount of regrowth has proved to be small.

54. *Climbers.*—Climbers, on the whole, do not do much damage, though in certain parts of the shola they are more abundant than others, and may require cutting regularly. *Entada scandens* is one of the commonest species.

SECTION 2.—INJURIES TO WHICH THE CROP IS LIABLE.

55. *Fire.*—Forest fires do more damage to the forest than any other source of injury, and are greatly responsible for the present unsatisfactory state of the crop. Although seedling, or young coppice growth of teak is plentiful, the sapling and pole stages are very markedly deficient. The cause of this is the repeated fires which cover large areas every year. Normally the fires are ground fires, burning the grass and fallen leaves. Such fires do little or no damage to old trees but are fatal to any existing regeneration. For a few years after the bamboos flower and die, very severe fires occur, and do considerable damage even to the large trees. Many of the old teak trees throughout the forest bear eloquent witness to the severity of these fires.

56. *Origin of fires.*—It has been stated that fires rarely start in the range, or at least within the Mount Stuart Working Circle, but during the last few years this has not been the case. Undoubtedly many fires come in from outside crossing the Cochin boundary west of Vengolimalai, on the dry leaf-covered bed of the Tekkadi river, and other fires frequently come in from the grazing areas in Pollachi range or over the ridge from Ulandi, but many fires also start within the Mount Stuart Working Circle. In the hot weather of 1930, out of 14 fires observed, 10 had their origin within the Mount Stuart or Tekkadi blocks. The majority of the fires occur on the upper grassy slopes of the ridges outside the Timber Working Circle, and do little damage there. Those however that invade the Timber Working Circles, or else start within them may do considerable damage. Most of the unsoundness found everywhere, especially in *Terminalia tomentosa*, *Terminalia paniculata*, *Lagerstroemia lanceolata* and *Adina cordifolia* is attributable to fires ; so also is the absence of the sapling and pole classes throughout the crop.

57. *Causes of fires.*—All the fires are caused through human agency. The majority of them are caused by jungle tribes (Kadirs and Hill Malsars), when collecting minor forest produce or hunting or else from their cooking fires which they do not trouble to extinguish properly. As far as is known there is little or no wilful incendiarism from malicious motives. As there is no grazing in the range, burning of grass areas for that purpose does not occur. Occasional fires escape while burning regeneration areas or fire-lines, but these are usually put out before they can do much damage.

58. *Prevention of fires.*—Fires coming into the range from without can be prevented by clearing and burning fire-lines along the boundaries. Fires commencing within the area are more difficult to prevent. The jungle tribes who cause them are not easy to control as they wander from place to place and have no fixed abode. Punitive measures are difficult to carry out effectively, and without a large protective staff, the prohibition of the collection of minor forest produce is impossible to enforce. Even the resident Kadirs and Malsars could not be effectually prevented from collecting minor produce. Something might be done by a system of rewards and punishments to the resident Kadirs and Malsars, but it is doubtful whether they would be able to control the wandering jungle tribes who come into the range to collect minor produce. A better scheme would probably be to collect the minor forest produce departmentally, with sufficient supervision to see that fires do not occur.

59. Under the previous working plan, Mr. Wood prescribed a detailed plan of fire-protection, consisting of a carefully worked out system of fire-lines and patrols, which, if it had been thoroughly carried out, would have effectually prevented fires from entering the range from without. The cost was estimated at approximately Rs. 2,000 per annum. This scheme was partially carried out for three years (1919–21) at a cost of approximately Rs. 1,400 per annum, after which protection was exclusively confined to the regeneration areas and depots, on account of lack of sufficient labour. The labour usually employed on fire protection was all absorbed by artificial regeneration works, and by transporting over the tramway the increased amount of timber exploited.

60. Any scheme of fire-protection, to be successful, must effectually prevent fires from entering the range from without, and it must prevent the occurrence of fires within the range by controlling as far as possible the actions of the wandering and resident jungle tribes. Fire-lines to be of any use must be swept clean of leaves at frequent intervals, and fire-tracing from guide lines must be repeated several times during the fire season, to remove the fallen leaves. Small fire-lines are of very little use in stopping a fire, especially if there is any wind accompanying it.

61. The following statement shows the areas burnt each year and the amounts spent on fire-protection. It is improbable, however, that the area figures are reliable :—

Year of Fire.	Area burnt in acres.		Total area burnt in acres.	Expenditure on fire protection.	Remarks.
	Inside Working Circle.	Outside working Circle.			
				RS. A. P.	
1916	1,298	165	1,463	..	Expenditure if any not known.
1917	..	1	1		
1918	680	..	680		
1919	..	640	640	1,353 0 6	Includes pay of fire patrols.
1920	117	150	267	1,311 0 0	Do.
1921	1,425	910	2,335	1,444 0 0	Do.
1922	1,000	..	1,000	1,450 0 0	Do.
1923	..	3	3	194 0 0	Only depots and regeneration areas protected.
1924	..	..	..	541 0 0	Do.
1925	..	..	..	469 3 6	Do.
1926	..	..	..	413 9 0	Do.
1927	..	..	..	642 4 0	Do.
1928	360	190	550	777 11 6	Do.
1929	..	4,640	4,640	1,084 5 0	Do.
1930	30	150	180	1,743 13 0	Do.

62. Before any marked improvement in the stocking of these forests by natural means can be hoped for, more attention must be given to fire-protection. Unless the area is absolutely protected against fire for at least ten years, most of the existing natural regeneration will be destroyed, and any schemes of artificial regeneration by patch sowings or other methods will prove ineffectual and a waste of money. The importance of effective fire-protection cannot be overstated.

63. *Other inanimate agencies.*—Other inanimate agencies such as winds, storms, lightning and drought cause very little damage.

64. *Animals.*—Elephants do serious damage by breaking down the young teak trees in the plantations creating terrible havoc. They also destroy ponam crops unless they are protected. Bison, sambhur and spotted-deer do damage by browsing regeneration of various species especially *Dalbergia latifolia* and *Pterocarpus marsupium*, and plantations of these species are not likely to succeed unless fenced against deer and bison. They also strip the bark off *Acrocarpus fraxinifolius* in young plantations, and browse young *Hopea* regeneration in the sholas.

65. *Insects.*—Defoliating caterpillars made their appearance in the teak plantations shortly after regular annual planting was started. In recent years, on an average about 500 to 600 acres of plantation are defoliated each year particularly in the plantations beyond Anaipadi. The defoliation is worst in dry seasons, rain being inimical to the caterpillar. It is the cause of much forking and production of epicormic branches. It is difficult to estimate the loss caused by defoliation, but it must be considerable, both as loss of increment, and loss by deterioration of the quality of the timber. The subject is being intensively investigated at Nilambur, and it is hoped that some means of checking the pest will be discovered shortly.

66. A stem borer (*Phassus malabaricus*) has been noticed recently in some of the young plantations between one and three years old. It is a white caterpillar, which makes a burrow up the pith of the young teak stems, with an external opening. Round this opening a cankerous growth forms, which frequently rings the young tree and kills it. So far only a very few cases of this borer have been noticed.

67. The seeds of *Terminalia paniculata* are attacked by a small borer which causes the high percentage of infertility usually found in this species. The insect is probably the same as that isolated at Nilambur, namely the weevil, " *Nanophyes terminalia* Marshall."

68. *Lantana.*—Lantana is now found almost all over the forest. Its spread has been very rapid. In areas where the canopy is dense, it does not flourish, and only a few small unhealthy plants are found here and there, not doing any harm, but forming a source of infection which would rapidly become a dense mass of the weed if the canopy were opened. In places where the canopy is open, Lantana invariably takes charge, becoming a dense impenetrable mass. The density of the Lantana growth is proportional to the openness of the canopy. The chief damage done by Lantana is that it suppresses any seedling regeneration that may be under it. Coppice regeneration usually manages to compete with it, as is seen by the present regrowth of timber species in the anti-malarial clearing round Mount Stuart which in 1926 was a dense mass of Lantana, and now, in 1930 is well stocked with coppice regrowth which is rapidly suppressing the Lantana. The other chief disadvantages of Lantana are that it makes the forest more inflammable in the dry weather, and it causes much inconvenience in getting about the forest. It also increases the cost of clearing demarcation lines, fire-lines, paths and areas for regeneration.

69. Efforts at eradicating Lantana by uprooting, repeated cutting, and by burning were tried under Mr. Wood's Working plan, but these all proved either too expensive or unsuccessful, and were soon abandoned. The best way of keeping down Lantana is to maintain a close canopy, as Lantana does not flourish under shade.

70. *Caesalpinia mimosoides* is another pest which is similar in its effects to Lantana. It is typically found in recently burnt areas which it occupies as a dense mass. Like Lantana it suppresses regeneration and obstructs movement about the forest, but being soft-stemmed it is possible to make a way through it by beating it down with heavy sticks.

71. *Bamboo.*—Bamboo has hitherto been regarded as a weed in the Mount Stuart forests, but now that a good ghaut road has been made, and transport facilities increased, good prices have been obtained for the bamboo coupes sold in recent years, and it may prove to be a very profitable crop. The supply however is greatly in excess of the demand, and will probably always be so, even when all the areas suitable for planting teak have been regenerated. The effect of bamboo in the mixed deciduous forest is to occupy the greater portion of the ground to the exclusion of timber trees. The bamboos seed and die periodically (about once every 32 years), and then fall down making the forest very inflammable. The fierce fires which almost invariably follow the death of the bamboos cause serious damage to the larger timber trees as

well as completely exterminating any existing regeneration. For several years subsequent to the flowering of the bamboos the canopy is left very open, and dense masses of Lantana, *Caesalpinia,* and other weeds and creepers cover the ground. What little regeneration survives this mass of undergrowth is quickly suppressed by the dense seedling regrowth of bamboos. It is probable that the value of the damage done to the forest during the ten years after the bamboos flower and die is greatly in excess of any profit obtained by exploiting the bamboos during the period when they produce saleable culms. Bamboos have, however, certain useful effects. It is noticeable that timber which is grown along with bamboos is cleaner, straighter and better grown than timber in areas without bamboos. Also, in clear-felling and regenerating an area by planting, the presence of bamboos ensures a good burn. When, however, the bamboos have died shortly before an area is clear-felled and planted, the burn is not so good, and the dense regeneration of bamboos from seed will probably cause considerable trouble and expense to clear. It has yet to be discovered how serious a difficulty this will prove to be. The bamboos have flowered and died throughout nearly the whole of the Mount Stuart area during the years 1926 to 1930.

72. *Climbers.*—The climbers which do most damage, both in the young plantations, and by strangling old trees in the natural forest are *Spatholobus Roxburghii*, *Acacia pennata* and *Zizyphus oenoplia.* Various other climbers invade the young plantations and have to be cut frequently in the first few years after formation.

73. *Grass and weeds.*—The coarse " Elephant grass " (*Imperata arundinacea*) is inimical to tree growth and kills out regeneration of teak and other species. Areas containing this grass are almost always unsuitable for planting. Weeds of all kinds retard the growth of young teak and other species by root competition in the same layer of the soil, making weeding in the first two years of a plantation essential. In the case of *Dalbergia latifolia* and *Pterocarpus marsupium,* which are badly browsed by deer, a growth of weeds serves to protect them from the browsing, though at the same time it undoubtedly retards their growth.

74. *Fungi.*—A fungus has been noticed recently attacking the teak leaves in young plantations and covering them with a white growth on the upper surface after the south-west monsoon. Later, orange coloured spores develop on the under surface of the leaves, which turn brown and die prematurely. This dying off occurs one to two months before the usual hot weather leaf-fall, and probably causes a slight loss of increment. This disease attacked portions of the 1927 and 1928 plantations in 1929 and 1930, but so far has not reached serious proportions.

CHAPTER III.—UTILIZATION OF THE PRODUCE.

SECTION 1.—AGRICULTURAL CUSTOMS AND WANTS OF THE POPULATION.

75. The ordinary wants of the neighbouring population on the plains in regard to fuel, agricultural implements and miscellaneous requirements are met from the forests of Pollachi range which intervene between the Mount Stuart forests and the plains, and there is no immediate likelihood of the Mount Stuart forests being indented on to supply such requirements.

76. Teak spokes and felloes are in demand to the extent of 300 to 400 sets a year, and these are supplied from the Mount Stuart forests.

77. The local demand for large bamboos for temporary constructions is also met from the Mount Stuart forests. Since the new ghaut road to Topslip was constructed the quantity of bamboos extracted has greatly increased.

SECTION 2.—MARKETS AND MARKETABLE PRODUCTS.

78. *Timber.*—Almost all the large timber exported from Mount Stuart has been absorbed by the Pollachi market, where it is usually sold by auction in the log. A certain amount of high grade timber has been supplied to the railways for carriage building, etc., and some of the very best logs of teak *Dalbergia latifolia*, and *Terminalia tomentosa* are exported to England. Recently, since the opening of the Pollachi-Dindigul railway some small lots of timber have been sent to Madura to test the market there, and were sold at satisfactory prices, and it is expected that this market, and possibly also a market at Dindigul can be profitably developed.

79. The capacity of the Pollachi market has been distinctly limited up to date, and it has been shown that on an average more than about one lakh of cubic feet of timber cannot be sold annually without a drop in prices. It is expected, however, now that transport facilities to Pollachi have been improved by the new line from Dindigul, and will shortly be further augmented by the line to Palghat now under construction, that bidders from more distant places will attend the Pollachi auctions and that the full outturn of the forests will be saleable at good prices.

80. In the Pollachi market, the size of the timber does not affect the prices appreciably. The same prices per cubic foot are realized for all sizes of logs of over about six feet in girth. Smaller logs may fetch slightly lower prices. Very large logs also tend to fetch lower prices as there is more likelihood of unsoundness and hidden defects being found in them.

81. The demand for the different species is variable, and is indicated below :—

Teak (*Tectona grandis*) is always in demand to an almost unlimited extent. It is chiefly used for constructional purposes, and owing to its reputation and reliability, it is frequently used where other less expensive timbers would suffice. There is never any difficulty in selling all the teak put on the market.

Teak poles are also greatly in demand, and the thinnings from the teak plantations should be easily disposed of at a profit.

Dalbergia latifolia (*Rosewood*).—There is a limited demand for high class rosewood of large sizes for furniture making, for which prices exceeding that of teak are often paid. A small quantity of the best and largest diameter logs is usually absorbed by the export market, but at the present moment there is no demand for it at all in England. When these two very limited markets have been supplied there is no demand for *Dalbergia latifolia* for purposes other than ordinary constructional work, and when sold for this purpose it fetches approximately the same price as *Terminalia paniculata*, or any other constructional timber.

Terminalia paniculata (*Pillamarudu*) is in demand as a general constructional timber, though the demand is not unlimited. It is usually preferred to *Terminalia tomentosa*, *Lagerstrœmia lanceolata*, and most of the other miscellaneous woods, except *Pterocarpus marsupium*.

Terminalia tomentosa (*Karumarudu*).—This species is unpopular at Pollachi, and it is difficult to get rid of the stocks at reasonable prices. This is chiefly due to the fact that planks and scantlings of Mount Stuart *Terminalia tomentosa* frequently open up and crack badly after sawing. Forest fires probably cause this defect. Figured *Terminalia tomentosa*, and burls and ‘fourches’ of this species, if nicely marked and of sufficiently large size, fetch fancy prices, and are greatly in demand abroad for veneers and panelling being sold under the name of Laurelwood. Most of the *Terminalia tomentosa* at Mount Stuart is, however, not figured and has very little grain. There is some doubt whether there are not two distinct varieties of this species, one of which has a beautiful grain, and the other no grain to speak of. *T. Crenulata* is considered by some to be the species that produces the figured wood. This point however requires verification.

Lagerstrœmia lanceolata (*Venteak*).—This species is in moderate demand as a general constructional timber, but does not fetch as high prices as *Terminalia paniculata*. Much of the Mount Stuart *Lagerstrœmia lanceolata* is unsound owing to severe forest fires.

Grewia tiliæfolia (*Thadasu*).—There is a moderate demand for this timber, which is very strong and makes good axe handles. It has also of recent years been used with great success for high class flooring.

Pterocarpus marsupium (*Vengai*).—Next to teak and *Dalbergia latifolia*, *Pterocarpus marsupium* is the most highly prized timber in the Mount Stuart forests. It is used as a general constructional timber and is also accepted for spokes and fellœs. These are more difficult to make than teak spokes and fellœs as *Pterocarpus marsupium* is very hard to split and they have to be cut out with the saw.

Adina Cordifolia (*Manjakadambai*) is not much in demand and fetches poor prices.

Xylia xylocarpa (*Irul*).—There is a moderate demand for this species, which fetches about the same prices as *Grewia*. It is an accepted sleeper wood.

Albizzia odoratissima (*Karuvagai*).—There is a local superstition against this excellent timber, and it is almost impossible to sell it.

Terminalia belerica (*Thani*).—This is also a good timber, but is considered an unlucky tree, and on account of this superstition cannot usually be sold.

Anogeissus latifolia (*Vekkali, Naval*).—Although a strong and durable timber, *Anogeissus latifolia* is not in demand, probably on account of its tendency to split when converted, and the difficulty in working it.

Stereospermum xylocarpum (*Vedankoranai*).—This timber can always be sold, and is popular for general constructional purposes.

82. Of the evergreen species the following are worthy of mention :—

Hopea parviflora (*Irumbogam*).—This species has hitherto not been put on the market in any quantity at Pollachi. It fetches about the same prices as *Pterocarpus marsupium*, but when it becomes better known it should fetch good prices.

Mesua ferrea (*Suruli*).—This timber is usually sold in the form of sleepers. There is little demand for it in any other form.

Calophyllum tomentosum (*Poon*), *Dysoxylum malabaricum* (*White cedar*), *Aglaia Roxburghiana* (*Sembil*) and several other species common in Karian Shola, are good general purpose woods, known as such on the West Coast, but hitherto they have hardly been sold at all in Pollachi. They should fetch about the same prices as *Lagerstrœmia lanceolata* when they become known.

83. Sawn material, in the form of planks and scantlings does not usually fetch sufficiently high prices to pay for the cost of conversion in a saw mill, though by hand-sawing it may be possible to realize a greater profit than by selling in the log, but only in certain cases and for particular purposes. Hand-sawn broad gauge sleepers usually show a handsome profit, though meter gauge sleepers scarcely pay for the cost of conversion. Certain species, notably evergreens such as *Dysoxylum malabaricum*, *Calophyllum tomentosum* and *Acrocarpus fraxinifolius* frequently sell better in the form of hand-sawn (small) ‘kolmarams’ than in the log.

84. Teak poles are usually in demand at Pollachi, and it should be possible to sell large numbers of them at a profit in Dindigul, Madura, and other places.

85. Previous to 1927 all auction sales at Pollachi were conducted by the District Forest Officer, but in 1927 the depot was handed over to the Forest Utilization Officer, who was in charge of the disposal of all the timber, teak poles, spokes and fellœs coming from the Mount Stuart. The Forest Utilization Officer and the Government timber agent have also been attending to sales outside Pollachi by finding other markets.

86. Overseas markets have been in the hands of the Forest Utilization Officer, and previous to 1927 all consignments sent to England were sold through the agency of Messrs. Howard Brothers in London. Subsequent to that date, Messrs. Peirce, Leslie & Co. have been the agents for shipping timber abroad. The chief species exported are teak, *Dalbergia latifolia*, and *Terminalia tomentosa*. Recently, in 1929, Messrs. Churchill & Sons have advised Messrs. Peirce, Leslie & Co. not to forward any further stocks as they have heavy stocks on hand. The slump is apparently due to large exports from Calicut by merchants who are now exploiting private forests on the West Coast, even in distant parts of the Wynaad.

87. The timber markets at Chalagudi and at Ernakulam in Cochin are the most accessible markets for the timber from the Ulandi and Palakadavu blocks of the Mount Stuart forests. These markets are both dull at present, and the prices realized will show a reasonable margin of profit only on teak and *Dalbergia latifolia* at the present rates of transport down the Cochin tramway. Hence, unless a considerable reduction in the transport rates on the tramway is made, departmental working of these blocks is out of the question.

88. Bamboos of large sizes are in great demand in the plains, and since the new ghaut road to Top Slip has been constructed, bamboo coupes have fetched good prices.

89. Minor forest products of various kinds exist in the working plan area, but hitherto they have not been sold to contractors on account of the danger of fires caused while collecting them. A list of the different kinds of minor produce said to exist in the range is given below, but very little is known about the quantities that are available, the best methods of collection, the qualities of the products, etc., and until departmental collection of minor produce is undertaken, little knowledge of this source of revenue will be gained. There is little doubt that an intensive study of minor products will indicate ways and means of enhancing the revenue derived from these forests. Pollachi, with its large weekly ‘ shandy ’ should be an ideal place for marketing them.

90. LIST OF MINOR FOREST PRODUCTS SAID TO BE FOUND IN THE MOUNT STUART FORESTS.

English name.	Vernacular name.	Scientific name.
Soapnut	Seekai	*Acacia concinna.*
Soapnut		*Sapindus trifoliatus.*
Myrabolams (Chebulic).	Kadukkai	*Terminalia chebula.*
,, (Beleric).	Thanikai	*Terminalia belerica.*
	Thattankottai	*Strychnos potatorum.*
	Sundakai	*Solanum pubescens.*
	Nellikai	*Phyllanthus emblica.*
	Velankai	*Anogeissus latifolia.*
Wild mangoes	Mangai	*Mangifera indica.*
Curry leaf	Karuveppilai	*Murraya koenigii.*
Cinnamon bark	Lavangam	*Cinnamomum zeylanicum.*
Cardamoms	Yelam	*Elettaraea cardamomum.*
Turmeric	Manjal	*Curcuma longa.*
Ginger	Inji	*Zingiber officinale.*
	Mattipal	*Ailanthus malabarica.*
White dammer	Kungiliam	*Vateria indica.*
Black dammer	Kurukungiliam	*Canarium strictum.*
	Marul manji	*Crotalaria sp.*
Pepper	Milagu	*Piper nigra.*
Canes	Pirambu	*Calamus viminalis.*
Honey	Ten	....
Wax	Melugu	....
Sambhur horns	Kadambi kombu	....
Deer horns	Man kombu	....

The above list is probably incomplete and at the same time some of the products mentioned in it may occur in such small quantities as to be not worth collecting.

SECTION 3.—LINES OF EXPORT.

A. Past History of Lines of Export.

91. Previous to 1850 all the timber extracted from the Mount Stuart forests was dragged to Top Slip, and from there it was skidded down the ghaut to Adivaram, whence it was carted to the Palghat river and floated to the coast.

92. Captain Michael in 1850, constructed a cart-load (now known as Michael's Trace), 6½ miles long from Top Slip to the Sichalipallam, at a cost of Rs. 4,139, to facilitate extraction. The last mile of this road lies in the Tekkadi leased forest.

93. The slip down the ghaut from Top Slip consisted simply of a steep drag path with poles laid across it whenever necessary. It was found to be very difficult to maintain in efficient order, and in 1856 Captain Michael traced a ghaut road to replace it. He claimed that he had obtained a trace with a moderate gradient down which the largest logs could safely be taken on wheels at a very moderate expenditure. Though he thought the road could be constructed at a low cost, this was not the opinion of the engineers at that time, and the proposal was shelved.

94. In 1868, however, the officer then in charge, Captain Gosling, actually constructed the road in less than five months at a cost of Rs. 4,009. The engineer's rough estimate had been Rs. 25,000. Apparently the original trace was slightly modified by Captain Gosling, and the road he made remained in use, in spite of its steep gradients and sharp curves for 56 years until it was replaced by the present ghaut road in 1924. The timber slide continued to be used as well as the road until the wire ropeway was put up in 1902 by Mr. Gass for transporting the planks and scantlings from the saw mill.

95. In 1888 Mr. Porter started the construction of the Mount Stuart Tramway which was the only line of export used within the forest for the next 38 years. The seven miles to Sungam were completed by 1891. About 1 mile and 7 furlongs of this went down the ghaut from Top Slip, but was soon taken up again as the gradients were found to be too steep. The final length of the line was 5 miles 200 yards.

96. The tramway was of a 2-foot gauge laid on corrugated metal sleepers. The rails were light, being only 14 lb. per yard. There were to start with 36 wagons, 5 crossings, 1 portable turn-table, 1 crane, and a weighing machine. The total capital cost was Rs. 60,086-14-8.

97. The estimated savings over carting were very hopeful. Carting was in the hands of a contractor who imposed what rates he liked, and the rate of carting to the top of the slip from Sungam was at that time stated to be Rs. 2-1-0 per candy of 12½ cubic feet. It was calculated that tramming could be done at 14 annas per candy for the same distance, though how this figure was arrived at is not stated.

98. The line was apparently laid without a proper survey and longitudinal section being taken. Innumerable difficulties were encountered on account of the sharpness of some of the curves which caused frequent derailments, and still more on account of the steepness of the track, which in places had a gradient of as much as 1 in 7 against the load. At first bullock traction seemed unsuitable and government elephants were used to drag the loaded trucks. These however proved to be even less suitable, and bullocks were again resorted to. It was found that logs weighing over 1 ton required three pairs of bullocks to drag them up the steepest parts of the line. The rails were found to be too light, and soon acquired an unsightly zigzag appearance.

99. The contractor's men adopted various means, such as putting grit in the axle boxes and locking the wheels to control the loads on the down grades, because the hand-brakes were found to be ineffective.

100. However most of these difficulties were got over. Some of the curves were straightened out, and in a few places the gradients were improved, and tramming went on almost continuously until 1926. In 1903 reports showed that the line and rolling stock were getting into bad repair and an investigation in 1904 revealed that, far from achieving a saving over carting, the working of the tram-line for the thirteen years of its existence showed a loss. The average cost of tramming including 6 per cent depreciation, and 4 per cent interest on undepreciated capital, was, after deducting possible savings on account of maintenance and extension of the existing cart-track, no less than Rs. 2-0-5·7 per candy of 12½ cubic feet. The average carting rate over that period was Rs. 1-6-0·2, indicating a loss of As. 10—5·5, per candy. These calculations scarcely gave a correct view of the situation because, if the tramway had not been there, carting rates would undoubtedly have been higher, and it might not have been possible to extract the same quantity of timber annually. The total loss over the first thirteen years of working was shown as Rs. 29,647-13-3 on 569,871 cubic feet extracted.

101. Subsequent reports on the tram-line all emphasized the bad state of the track, the steepness of the gradients and the necessity for spending large sums of money in regrading the track and putting it into better order. Difficulties were reported in getting spare parts and rails of the correct sizes, and delays were caused through the wrong parts being sent.

102. In 1911 a survey and estimate was made by Mr. Rouse of Messrs. Rouse Broonfield & Co. for a carefully graded tram-line system to be worked by bullock traction from Sungam through the Tekkadi forests to Ayyasamimudi, whence it was to descend by an inclined plane into the Gudaravalli valley, and continue along eastward until it joined the road from Sethumadi to the foot of the slip. Nothing however came of this until, in 1916, Mr. P. M. Lushington again brought the matter up. He says: "I cannot ascertain why this scheme was rejected. This project was estimated to cost Rs. 1,10,000 and I feel sure that if it had been constructed, we should have by now been able to have brought down several lakhs worth of timber. I would now urge that this project be put in hand without delay to enable us to work out our valuable material. There are not many forests where we can show that opening up will immediately repay itself and this is certainly the case with Tekkadi. (The surveys, and drawings of this tramway are filed with the Mount Stuart Working Plan records in the Third (Working Plans) Circle, Conservator's office).

103. At the same time an idea of a steam tramway was brought up by Mr. Bright, the Forest Engineer, and while it was being investigated Mr. Rouse's Tramway scheme was shelved. Mr. Lushington describes Mr. Bright's scheme for a steam tramway as fantastic, and dismisses it as such, enumerating many of the obvious difficulties that it would entail. Nevertheless the idea somehow took hold, and in 1917-18, Mr. Marshall got out plans and estimates for it. The scheme was to connect Anamalai, a station on the proposed Pollachi-Palghat railway, with compartment 18 of the Tekkadi forests. The alignment was slightly over 21 miles in length and was to be carried up the Ayyasamimudi slope by eight reversing stations. The original estimate was for Rs. 6·45 lakhs, but owing to post-war rises in the prices of machinery, it was raised to Rs. 10·66 lakhs. The profit was calculated to be 1·23 per cent on an estimated outturn of 100,000 cubic feet per annum, and 14·95 per cent on an outturn of 200,000 cubic feet per annum, the rate of interest charged for purposes of the financial statement being 5½ per cent. The calculations were made by the Forest Engineer, and seem to have been open to much criticism.

104. Mr. Tireman, then Conservator of the fifth Circle, strongly criticized the scheme on the following points:—

(*a*) The eight reversing stations were dangerous especially as the engine was not shifted at each station.

(*b*) That it was not financially sound to examine the scheme solely from the point of view of the yield on capital invested.

(*c*) That alternative schemes, involving less capital expenditure, such as road construction and extraction by motor lorries had not been gone into.

105. As a result, Mr. Cox, the Chief Conservator, visited Mount Stuart early in 1920 and after inspecting the alignment and discussing the matter with the local Forest officers, decided to abandon the steam tramway scheme as it was unnecessary and " would embarrass the whole future finance of the forest development in the locality."

106. The alternative scheme of a well-graded metalled ghaut road from Sethumadi to Top Slip and thence to Anaipadi was approved.

107. In the meantime, the old tramway from Sungam to Top Slip still continued to function. At the end of the 1919-20 tramming season it was in very bad order, and the possibility of realigning portions of the line so as to improve the gradient, tap new areas and increase output was gone into but finally abandoned on account of expense, especially as it had been decided that the tramway was not to be a permanent means of extraction.

108. Early in 1922, Mr. Wimbush submitted a report on a road scheme in which he was strongly in favour of a good system of roads as opposed to tramways. His chief points were—

(i) The eagerness with which cartmen came forward to cart from Top Slip to Pollachi was sure proof that the whole of the carting required could be done on contract.

(ii) With tramways there would be a " break of bulk " (transhipment) at Top Slip, the rail head, and a depot would have to be maintained.

(iii) With tramways cattle would have to be maintained departmentally, which was both expensive and risky.

(iv) A road system would be more elastic, in that carting could adapt itself more readily to fluctuations in outturn.

(v) A road system would enormously facilitate inspections.

(vi) If cartmen and contractors could take their carts into the coupes and regeneration areas a revenue would be obtained from the sale of fuel and bamboos.

109. These arguments among others decided the policy of scrapping the steam tramway scheme in favour of the ghaut road, and a road system within the forest.

110. Mr. Marshall made a final trace for the new ghaut road with a ruling gradient of 1 in 23. The total length of the ghaut portion from Sethumadi to Top Slip was just over 6½ miles. Actual work on the road commenced in August 1921, and the road was opened for traffic in October 1924. The extension to Anaipadi was completed early in 1926, and as soon as it was open for traffic the old tramway was dismantled and all the live-stock sold. The total cost of the new ghaut road from Sethumadi to Anaipadi, a distance of 14 miles was Rs. 3,27,987-7-5. The work was carried out by the Forest Engineering Branch.

B. Present Lines of Export and Future Development.

111. At present the only outlets for the timber of the Mount Stuart Forests are (1) *via* the new Top Slip ghaut road to Sethumadi, and (2) *via* the old Tekkadi timber slide at Ayyasamimudi to the end of the cart-track down the Gudaravalli Valley, which joins the Top Slip-Sethumadi road about one mile from Sethumadi.

112. Within the forest the ghaut road has been extended to Anaipadi, and a fair weather branch road from the 21st mile 5th furlong has been constructed for about 5 miles into the Sichalipallam, and will eventually, join the present road near Sungam.

113. The road system has developed too slowly for the fellings, and the position is now that more roads are needed immediately to serve the coupes to be felled in the next few years. A complete main road system has been drawn up which will be constructed in the next thirty years, and the timber slide at Tekkadi, which has not been used and which causes a " break in bulk " that is more expensive than direct carting along a metalled road, will be replaced by a new ghaut road near Ayyasamimudi. As was emphasized by Mr. P. M. Lushington as long ago as 1910, this is the natural exit for all the timber from the Tekkadi leased forest, being more than 600 feet lower than Top Slip. At present the timber slide is served by a badly graded cart-track from Tekkadi, which formerly went within the Tekkadi leased forest as far as a point on the Tekkadi river about 2 miles from Kachithodu. This cart-track has not been used for many years, and is now impassable for carts, and in some places cannot even be traced. The first two and a half miles of road from the bottom of the timber slide towards Sethumadi are also badly graded. Part of it goes along a sandy river-bed, and there are gradients up to 1 in 9 against the load. Consequently a bullock-cart cannot carry a load of more than about 25 cubic feet, which makes the cost of carting prohibitive. This portion will be replaced by a properly graded road when the new Ayyasamimudi ghaut road is constructed.

114. The question of the relative merits and cost of (1) constructing this new ghaut road, or (2) of using the old timber slide and carting to the top and from the bottom of the slide, or (3) of carting all the way round *via* Top Slip and down the existing ghaut road, has been gone into exhaustively, and it has been shown that the new ghaut road is preferable in all respects.

115. The proposed road system within the forest will eventually connect up at Sungam with the existing roads from Top Slip.

116. From Pollachi, timber and other produce may be exported by rail to Coimbatore, Dindigul and Madura, and when the new line to Palghat, which is now under construction, is opened, it will be possible to send produce to the West Coast markets by rail.

117. The only line of export for the timber from the Ulandi and Palakadavu valleys is down the Cochin Forest Tramway to Chalagudi, and thence to the West Coast but rates on this tramway are at present too high to permit of any departmentally exploited timber except teak and *Dalbergia latifolia* being taken down at a profit. The present rates charged are as follows :—

Species.	Rate per candy (12½ c. ft.) per mile.		From terminus one mile from the Cochin boundary to Chalagudi —51 miles.	
	A.	P.	A.	P.
			(per cubic foot.)	
Teak	3	6	14	3·4
Rosewood				
Ebony				
Other species	2	6	10	2·4

These rates are for logs less than 35 feet long. For logs over 35 feet the rates are doubled owing to difficulty in handling and in getting them round curves.

SECTION 4.—METHODS OF EXPLOITATION AND THEIR COST.

118. Hitherto all timber exploitation at Mount Stuart has been done departmentally, and the method employed is as follows.

119. The area to be felled by selection fellings is selected by the District Forest Officer so as to give an approximate total yield of 140,000 cubic feet as far as can be estimated from the data given in Mr. Wood's working plan. Survey and demarcation is carried out in March, and all trees over 6 feet in girth are numbered and enumerated in April. One ranger and two foresters carry

out this work. They measure the girth at breast height, and estimate the length of saleable bole and the cubical contents, and enter them in " Form 3 ". Marking is done with tar numbers at the foot of the tree after removing the bark and sapwood, and is carried out serially irrespective of species.

120. The same procedure is carried out in the case of clear-fellings, except that all trees down to the minimum exploitable girth are marked and numbered.

121. Felling is begun within a week of the outbreak of the south-west monsoon and is done by Cochin and Palghat axemen and Malsars. It is paid for by the cubic foot.

122. Logging which consists of cutting the trees into convenient sized logs, snouting, cutting drag holes and removing the bark at the centre for measurement is done by the same coolies. The length of the logs is chiefly determined by the difficulty of carting. The coolies work in parties of two or three, and their outturn is divided among them. The felling forester or the ranger measures up the logs, and the Range Officer pays.

123. Numbering the logs is done by a different coolie. Each log is marked with the year of felling, the coupe number, the tree enumeration number, and a letter A, B, or C according as the log is the butt, second or third log respectively.

124. Logs of large girth with cubical contents of over 60 cubic feet are sawn longitudinally to facilitate carting. This is avoided if possible, and it is found better to square drastically to avoid longitudinal cutting if it is possible to do so. Longitudinal cutting is paid for by the cut, the rate varying with the size of the log.

125. Measurement of the girth is taken at the centre under bark to the nearest inch, and the length is measured from the drag hole. The volume is looked up in " Hoppus " or any other tables giving " quarter girth " volumes. No deductions are allowed for unsoundness or other defects except to cartmen. Checkmeasurement of logs is done by the District Forest Officer or by the Range Officer.

126. In measuring half logs, the curved surface is measured and the volume is ascertained from the tables as if it were a log whose girth was equal to the curved surface measurement. This volume is then multiplied by two to give the volume of the half log. The method is fairly accurate provided that the cut is sufficiently near the centre of the log, but if the log is unequally divided the sum of the volume of the two halves thus measured is less than the volume of the whole log before cutting.

127. The logs are then classified by the Depot Ranger, Pollachi, into the following grades :—

A—E Export logs.
A
B—1 For sale in Pollachi depot.
B—2 Formerly supplied to the saw mill, but now mostly sent to Pollachi.
C
D Poor logs not worth carting to Pollachi ; sold locally in the forest.

The classification is made by eye and general intelligence.

128. Dragging from the felling site to the roadside depots is done by elephants supervised by the forester in charge of them.

129. Loading on to carts is done by the cartmen assisted when necessary by elephants and is supervised by the depot keepers. The elephants load only such logs as are large or badly placed.

130. Carting to Pollachi is paid for by the cubic foot, the rates varying according to the distance from Top Slip. Logs over 60 cubic feet in volume are paid for at 25 per cent extra above ordinary carting rates. Such logs are frequently carted. There is usually not much difficulty in getting the whole year's outturn carted within the year. Carts with 3-inch tyred wheels have recently been introduced, and these save a considerable amount in road repairs.

Such broad-tyred carts are always given first load, and now very few of the ordinary narrow-tyred carts are used for carting timber.

131. Invoicing is done by the depot-keeper at the time of loading. There are no checking stations on the way to see that cartmen do not remove timber illicitly, and no need for them has been found up to date.

132. While the saw mill was in operation, logs had to be carted from the coupe to the saw mill, a matter of a few miles. Considerable difficulty was experienced in getting the cartmen to do this, and it is only when they were paid high rates, and promised a log to take to Pollachi within a few days that they could be persuaded to do it.

133. *Timber registers and forms.*—In 1925 a new system of timber registers and forms was introduced in connexion with the commercial system of accounting, and the forms prescribed in the Madras Forest Code were discontinued. The new registers and forms have been found to be superior to the old forms in many ways, and in the event of the commercial system of accounting being discontinued, it is recommended that some of the new timber forms be retained.

134. The current rates paid for the various stages of exploitation are given in the following table :—

Current Exploitation Rates.

Work.	Rate.			Unit.
	RS.	A.	P.	
Felling and conversion of timber between 3 feet and 6 feet in girth	0	6	0	Per candy of 12½ cubic feet.
Felling and conversion of logs above 6 feet in girth ..	0	8	0	Do.
Sawing longitudinally—				
Logs between 75 cubic feet and 100 cubic feet ..	6	0	0	Per log.
,, 100 cubic feet and 125 cubic feet ..	8	0	0	Do.
,, 125 cubic feet and 150 cubic feet ..	10	0	0	Do.
,, 150 cubic feet and 175 cubic feet ..	12	0	0	Do.
Logs over 175 cubic feet	15	0	0	Do.
Cross cutting by saw—				
Logs below 42 inches girth	0	8	0	Do.
,, between 42 and 60 inches	0	12	0	Do.
,, above 60 inches	1	0	0	Do.
Conversion of spokes and felloes	6	0	0	Per set of 24 spokes and 12 felloes.
Carting spokes and felloes from roadside depot to Pollachi.	4	0	0	Per set.
Carting timber to Pollachi—				
From Tannirpallam	0	4	0	Per cubic foot.
,, Topslip	0	5	0	Do.
,, 19th mile	0	6	0	Do.
Between 21st mile and 23rd mile	0	6	6	Do.
,, 23rd mile and Anaipadi	0	6	9	Do.
Excess rate for logs over 60 cubic feet from 21st to 23rd mile.	0	1	6	Do.
Excess rate for logs over 60 cubic feet from 23rd mile to Anaipadi.	0	1	9	Do.

135. Dragging costs have been worked out for the last three years and are—

Year.	Quantity of timber dragged.	Cost of dragging per cubic foot.		
	C.FT.	RS.	A.	P.
1927–28	90,046	0	3	2·69
1928–29	135,820	0	2	7·10
1929–30	126,972	0	2	0·85

136. *Total cost of production.*—Since the introduction of commercial accounting in this division a figure has been worked out by the commercial auditors for the production cost of timber from Mount Stuart. Their rates are the averages for the total annual production of timber, excluding poles from thinnings and bamboos.

Cost of log production.

	1926–27.		1927–28.		1928–29.		1929–30.	
	Quantity extracted.	Rate per cubic foot.	Quantity extracted.	Rate per cubic foot.	Quantity extracted.	Rate per cubic foot.	Quantity extracted.	Rate per cubic foot.
	C.FT.	A. P.	C.FT.	A. P.	C.FT.	A. P.	C.FT.	A. P.
Felling and logging ..	66,525	0 10·54	96,345	0 7·95	132,095	0 7·20	128,738	0 7·54
Dragging ..	70,321	5 0·52	90,046	3 2·69	135,820	2 7·10	124,469	2 0·85
Carting to Pollachi ..	77,723	4 1·36	52,505	5 0·87	81,584	6 2·92	74,315	6 4·10
Sawing or squaring to facilitate carting..	..	..	68,585	0 2·17	81,584	0 2·59	74,315	0 3·35
Total actual cost of exploitation ..	..	10 0·42	..	9 1·68	..	9 7·81	..	9 3·84

The above figures do not include overheads, which, as apportioned by the commercial auditors, have been open to much criticism, and no useful purpose will be served by quoting them here.

SECTION 5.—PAST AND PRESENT PRICES.

137. There is very little information available about the prices realized at timber sales previous to 1915 because no control records were maintained for Mr. Porter's working plan. In 1886 it was stated that the market price of teak logs was Rs. 2-2-0 per cubic foot. After the Bombay dockyard and the Madras Arsenal had ceased to obtain their timber supplies from the Mount Stuart forests, great difficulty was experienced in disposing of all the timber extracted at reasonable prices. Previous to 1900, the prices were very low, and teak and *Dalbergia latifolia* were the only species which made any profit. After 1900 prices rose very gradually until 1915 when the war caused a slight slump in the timber market. Immediately after the war there was a scarcity of timber, and prices rose to extraordinary heights in 1919 to 1921, since when they have dropped irregularly. The lowest figures since the war were reached in 1926 to 1928 when there was a slump in timber prices. The Pollachi depot was at the same time greatly overstocked with timber, much of which had lain there for several years and had deteriorated badly. The introduction of the saw mill in 1926 to convert the surplus logs into scantlings did not appear to have any beneficial effect on the log prices at that time.

138. The size of the logs does not appear to affect the prices very noticeably. Logs of over 6–7 feet in girth do not show an increase in value with size. In fact very large logs tend to fetch lower prices on account of the greater likelihood of unsoundness and hidden defects.

139. The following statement shows the average prices realized for timber in the log, and for spokes and felloes, in past years :—

Name of species. (1)	Vernacular name. (2)	Form of produce. (3)	1915–16.		1916–17.		1917–18.		1918–19.		1919–20.		1920–21.		1921–22.		1922–23.	
			Quantity sold. (4)	Average price realized per cubic foot. (5)	Quantity sold. (6)	Average price realized per cubic foot. (7)	Quantity sold. (8)	Average price realized per cubic foot. (9)	Quantity sold. (10)	Average price realized per cubic foot. (11)	Quantity sold. (12)	Average price realized per cubic foot. (13)	Quantity sold. (14)	Average price realized per cubic foot. (15)	Quantity sold. (16)	Average price realized per cubic foot. (17)	Quantity sold. (18)	Average price realized per cubic foot. (19)
			C.FT.	RS. A. P.	C.FT.	RS. A. P.	C.FT.	RS. A. P.	C.FT.	RS. A. P.	C.FT.	RS. A. P.	C.FT.	RS. A. P.	C.FT.	RS. A. P.	C.FT.	RS. A. P.
Tectona grandis ..	Teak ..	Round ..	9,073	1 14 5	4,330	1 12 2	21,996	2 6 9	13,225	2 12 3	7,444	3 9 1	21,883	2 12 10	51,280	2 11 1	53,245	2 0 7
		Sawn ..	6,665	1 15 1	..	..	..	..	..	..	..	..	3,996	2 15 8	..	..	14,053	2 2 4
		Squared ..	..	..	..	..	..	..	..	..	..	..	319½	2 12 2	..	..	176	3 12 0
		Poles ..	..	..	..	..	..	..	..	..	1,309	2 10 11	1,327	1 5 7	..	..	306	0 8 9
		Spokes and felloes.	..	..	..	..	..	..	..	..	262 sets.	23 7 1	313 sets.	11 15 0	120 sets.	20 0 0	1,986 spokes 1818 felloes.	..
		Planks ..	..	..	..	..	..	..	..	..	..	..	8	4 6 0	..	..	..	..
		Scantlings	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dalbergia latifolia ..	Rosewood ..	Round ..	497	1 5 11	722	2 0 11	480	1 10 10	39	2 0 0	223	4 6 1	423	3 0 1	2,533	2 2 8	2,936	2 8 11
		Sawn ..	..	..	..	..	..	..	..	..	..	..	90	4 3 0	..	..	..	..
		Poles ..	..	..	..	..	..	..	..	..	..	..	16	1 6 0	..	..	..	..
		Squared ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Terminalia tomentosa.	Laurelwood Karimarudu.	Round ..	4,793	0 11 0	12,106	0 12 4	24,601	0 13 9	14,755	0 13 7	6,385	1 6 7	13,896	0 13 9	22,027	1 2 1	25,443	1 0 3
		Sawn ..	..	..	..	..	..	..	..	..	..	..	4,699	0 15 1	..	..	1,722	1 4 11
		Squared ..	..	..	..	..	..	..	4,630	1 11 0	..	..	263	1 0 0	..	..	657	1 10 6
		Poles ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Terminalia paniculata.	Pillamarudu.	Round ..	1,361	0 8 4	4,906	0 12 5	6,175	0 14 11	2,771	0 13 8	1,400	1 12 9	3,798	1 3 1	10,152	1 3 0	15,439	1 1 11
		Sawn ..	..	..	..	..	..	..	..	..	..	..	532	0 15 7	..	..	551	1 3 7
		Squared ..	..	..	..	..	..	..	1,159	1 10 11	..	..	..	..	..	..	275	1 10 9
		Poles ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pterocarpus marsupium.	Vengai ..	Round ..	120	0 11 6	50	0 12 6	47	1 5 9	..	..	179	2 14 2	201	2 0 11	1,119	1 9 6	1,133	1 3 8
		Sawn ..	163	0 8 1	..	..	..	..	..	..	..	..	106	2 0 0	..	..	34	1 12 0
		Squared ..	..	..	..	..	..	..	..	..	..	..	214	1 9 2	..	..	55	1 13 0
Lagerstroemia lanceolata.	Venteak ..	Round ..	177	0 11 11	1,875	0 10 10	3,240	1 7 6	1,139	1 4 3	989	1 9 4	1,819	1 6 3	5,754	1 8 0	12,865	1 1 9
		Sawn ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	102	1 8 7
		Squared ..	..	..	..	..	..	..	1,495	1 11 7	..	..	..	..	..	..	..	..
Xylia xylocarpa ..	Irul ..	Round ..	631	0 7 1	1,811	0 15 7	1,098	0 11 2	1,413	1 2 10	187	2 4 0	..	..	342	0 12 9	1,067	1 0 7
		Sawn ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
		Poles ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Adina cordifolia ..	Manjakadambai.	Round ..	80	0 7 8	661	0 11 8	2,894	0 8 7	1,353	0 6 2	2,302	1 5 3	879	1 0 6	1,525	0 14 0	2,784	0 13 11
		Sawn ..	..	..	..	..	..	..	..	..	..	..	479	0 15 8	..	..	1,479	0 12 9
		Squared ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Grewia tiliaefolia ..	Thadasu ..	Round ..	..	..	149	0 11 5	33	0 11 8	291	0 15 8	68	0 9 3	37	0 10 0	1,096	1 3 2	8,062	0 15 6
Albizzia odoratissima.	Vagai ..	,, ..	..	..	..	..	29	0 8 9	..	..	..	..	316	0 10 2	691	1 0 3	2,869	0 13 0
Stereospermum xylocarpum.	Vedankornai.	,, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	906	1 3 0
Stephegyne parvifolia.	Nirkadambai.	Round ..	..	..	..	..	..	..	144	0 4 10	164	0 13 0	411	1 0 6	1,005	0 13 0	737	0 11 1
		Squared ..	..	..	..	..	37	1 11 5	..	..	..	..	..	..	..	..	..	..
Terminalia belerica.	Thani ..	Round ..	..	..	..	..	..	..	28	0 10 10	222	0 15 6	123	0 10 5	42	1 2 0	208	0 12 2
		Squared ..	..	..	..	..	..	..	60	1 10 11	..	..	..	..	..	..	..	..
Anogeissus latifolia.	Vekkali ..	Round ..	..	..	..	..	32	0 9 0	..	..	..	..	72	1 9 0	265	0 12 6	1,084	0 12 4
		Squared ..	..	..	..	..	..	..	35	1 10 11	..	..	..	..	..	..	..	..
Schleichera trijuga ..	Puvathi ..	..	..	..	..	..	..	..	..	..	..	..	..	..	41	1 0 0	..	..
Odina wodier ..	Anakarai ..	..	..	..	..	..	..	..	..	..	..	..	..	..	18	1 3 0	139	1 2 3
Gmelina arborea ..	Kunnil ..	..	..	..	..	..	..	..	..	..	..	..	76	1 0 0	..	..	53	1 1 0
Bridelia retusa ..	Mulvengai ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	619	1 0 5
Cassia fistula ..	Konnai ..	..	..	..	..	..	..	..	..	..	..	..	160	0 11 6	..	..	..	..
Saccopetalum tomentosum.	Kanakaitha.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	111	1 3 7
Dolichandrone rheedii.	Vilpathri ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	127	0 13 7
Hopea parviflora ..	Irumbogam.	..	..	..	..	..	..	..	51	2 5 0	..	..	..	..	..	..	..	..
Mesua ferra ..	Ironwood Suruli	..	..	..	..	..	..	..	..	..	..	..	1,402	1 6 6	..	..	..	..
Calophyllum tomentosum.	Poon ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Miscellaneous ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	20	1 1 0	..	..
Do. ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	24	0 9 0	..	..

Name of species.	Vernacular name.	Form of produce.	1923–24.		1924–25.		1925–26.		1926–27.		1927–28.		1928–29.		1929–30.	
			Quantity sold.	Average price realized per cubic foot.	Quantity sold.	Average price realized per cubic foot.	Quantity sold.	Average price realized per cubic foot.	Quantity sold.	Average price realized per cubic foot.	Quantity sold.	Average price realized per cubic foot.	Quantity sold.	Average price realized per cubic foot.	Quantity sold.	Average price realized per cubic foot.
			(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)
			C.FT.	RS. A. P.	C.FT.	RS. A. P.	C.FT.	RS. A. P.	C.FT.	RS. A. P.	C.FT.	RS. A. P.	C.FT.	RS. A. P.	C.FT.	RS. A. P.
Tectona grandis ..	Teak ..	Round ..	35,003	2 2 10	25,626	2 3 2	18,221	2 2 1	25,599	1 14 8	31,212	1 15 4	36,909	2 6 1	37,037	2 2 11
		Sawn ..	9,628	2 6 11	2,509	2 7 11	6,757	2 7 3	6,923	2 1 3	..	..	5,680	2 8 3	7,564	2 5 9
		Squared ..	784	3 3 1	384	3 5 1	646	2 7 0	1,446	2 4 6	..	..	..	..	..	..
		Poles ..	147	0 3 9	383	0 5 11	2,465	0 3 5	1,706	0 0 7	..	..	1,773	0 5 3	..	..
		Spokes and felloes.	36 sets.	21 0 0	81 sets.	21 5 3	138 sets.	17 9 9	444 sets.	18 7 4	53 sets.	17 11 9	581½ sets.	19 8 3	78½ sets.	20 9 1
		Planks ..	965	5 10 0	..	..	..	..	..	..	..	..	..	..	..	..
		Scantlings	494	1 4 7	69	1 3 7	..	..	..	..	..	..	..	..	..	..
Dalbergia latifolia ..	Rosewood ..	Round ..	2,894	2 5 3	1,265	2 14 11	1,723	3 2 8	2,747	1 14 8	9,167	1 12 0	8,915	1 15 5	5,852	1 14 4
		Sawn ..	200	2 6 0	220	1 10 2	404	2 2 9	804	2 6 4	..	..	..	..	..	..
		Poles ..	..	..	..	..	53	0 5 7	..	..	..	..	..	..	..	..
		Squared ..	..	..	..	..	123	2 9 2	28	3 0 0	..	..	..	..	..	..
Terminalia tomentosa.	Laurelwood Kari-marudu.	Round ..	22,322	0 15 5	7,338	1 0 10	16,992	0 15 3	5,090	1 0 2	4,263	1 0 1	8,611	1 3 1	11,989	1 1 5
		Sawn ..	4,309	0 14 2	1,752	0 14 3	1,942	0 10 6	549	1 0 9	..	..	..	..	..	..
		Squared ..	162	1 5 0	69	0 3 9	74	1 0 7	567	1 3 3	..	..	..	..	..	..
		Poles ..	..	..	13	13 10 1	289	0 3 2	..	..	..	..	..	..	..	..
Terminalia paniculata.	Pillamarudu.	Round ..	8,619	1 2 6	6,297	1 3 11	7,934	1 2 1	12,816	1 1 5	11,143	1 3 0	9,261	1 3 9	11,941	1 3 3
		Sawn ..	712	1 7 0	409	1 5 1	941	0 13 8	1,129	1 3 2	..	..	..	..	..	..
		Squared ..	160	1 12 0	..	..	165	1 3 11	111	1 8 0	..	..	..	..	..	..
		Poles ..	..	..	16	14 1 3	244	0 13 10	..	..	..	..	..	..	..	..
Pterocarpus marsupium.	Vengai ..	Round ..	548	1 2 5	..	..	71	1 3 0	507	1 0 11	3,587	1 1 1	5,899	1 3 2	8,733	1 2 9
		Sawn ..	..	..	..	..	..	..	632	1 3 5	..	..	..	..	..	..
		Squared ..	..	..	..	..	242	1 8 11	57	1 5 2	..	..	..	..	..	..
Lagerstroemia lanceolata.	Venteak ..	Round ..	7,715	1 2 4	4,850	1 3 2	6,337	1 1 4	5,811	0 14 9	15,520	0 13 7	4,343	1 4 1	6,318	1 1 8
		Sawn ..	..	..	..	..	..	..	64	1 4 0	..	..	..	..	..	..
		Poles ..	..	..	14	14 13 3	250	0 11 4	..	..	..	..	..	..	..	..
Xylia xylocarpa ..	Irul ..	Round ..	1,078	1 4 9	607	1 3 2	288	0 12 4	54	0 8 6	3,748	0 15 8	114	1 1 1	..	..
		Sawn ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
		Poles ..	..	..	9	16 11 5	..	..	..	..	..	..	..	..	..	..
Adina cordifolia ..	Manjakadambai.	Round ..	1,370	1 1 6	570	1 6 8	1,093	0 14 11	1,420	0 12 4	3,424	0 9 2	..	..	3,753	0 14 11
		Sawn ..	1,020	1 3 7	676	1 4 9	1,454	1 0 8	595	0 13 10	..	..	..	..	..	..
		Squared ..	273	1 14 0	..	..	82	0 8 11	..	..	..	..	..	..	..	..
Grewia tiliaefolia ..	Thadasu ..	Round ..	3,494	0 14 3	157	1 1 0	674	1 2 0	412	0 14 8	941	0 14 10	2,045	0 14 4	3,294	0 12 8
Albizzia odoratissima.	Vagai ..	,, ..	1,187	0 11 5	480	0 9 5	225	0 9 7	406	0 13 8	1,540	0 10 2	..	..	..	..
Stereospermum xylocarpum.	Vedankornai.	,, ..	277	1 1 11	224	1 6 8	859	1 1 11	78	1 2 0	142	0 10 9	..	..	..	..
Stephegyne parvifolia.	Nirkadambai.	Round ..	444	0 12 0	225	0 8 1	..	..	..	..	772	0 6 4	..	..	..	..
		Squared ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Terminalia belerica.	Thani ..	Round ..	468	0 14 10	55	0 8 0	125	0 1 8	..	..	..	..	..	..	..	..
		Squared ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Anogeissus latifolia.	Vekkali ..	Round ..	612	0 11 2	150	0 14 9	508	0 12 6	..	..	582	0 9 1	..	..	..	..
		Squared ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Schleichera trijuga ..	Puvathi ..	Round ..	..	..	..	..	15	0 8 6	..	..	..	..	..	..	..	..
Odina wodier ..	Anakarai ..	,, ..	126	0 9 0	19	0 7 0	..	..	..	..	..	..	..	..	..	..
Gmelina arborea ..	Kunnil ..	,, ..	..	..	..	..	23	0 9 6	..	..	..	..	..	..	..	..
Bridelia retusa ..	Mulvengai ..	,, ..	299	0 10 2	..	..	14	0 5 0	..	..	271	0 12 6	..	..	..	..
Cassia fistula ..	Konnai ..	,, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Saccopetalum tomentosum.	Kanakaitha.	,, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dolichandrone rheedii.	Vilpathri ..	,, ..	..	..	158	0 8 0	..	..	..	..	67	0 8 5	..	..	..	..
Hopea parviflora ..	Irumbogam.	,, ..	..	..	..	..	227	1 7 11	..	..	435	1 0 10	..	..	..	..
Mesua ferra	Iron wood Suruli	,, ..	..	..	186	1 6 0	..	..	297	0 13 11	..	..	..	..	..	..
Calophyllum tomentosum.	Poon ..	,, ..	114	1 1 0	502	1 6 7	..	..	..	..	..	..	..	..	..	..
Miscellaneous ..	..	Round ..	..	..	..	..	..	..	..	..	6,429	0 7 0	9,277	0 12 3	6,224	0 15 11
Do. ..	..	Sawn ..	..	..	..	..	..	..	..	..	..	..	9,218	1 3 7	6,667	0 15 5

140. *Export sales.*—Every year since 1923–24 a few of the finest logs of teak, *Dalbergia latifolia* and *Terminalia tomentosa* have been selected and shipped to England where they have been sold through timber agents, on a commission basis. The results of these sales are shown in the following statement. It will be noticed that previous to 1928–29 *Dalbergia latifolia* and *Terminalia tomentosa* showed a very handsome profit, but in 1929 and 1930 the London market for these species has been dead, and the agents in London have written asking that no further consignments be sent at present as they have not been able to dispose of the stocks on hand.

141. In 1927–28, a consignment of miscellaneous species, namely, *Adina cordifolia*, *Albizzia odoratissima*, *Terminalia paniculata*, *Calophyllum tomentosum* and *Lagerstrœmia lanceolata* was sent, but as one would expect with such unknown timbers, they all fetched very low prices and showed a loss.

142—*Statement showing the results of export sales in London.*

Species.	Description.	Year of sale.	Quantity sold in cubic feet.	Prices realized per cubic foot.	Cost of production, transport, etc., per cubic foot.	Net profit per cubic foot.	Net loss per cubic foot.
				RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
Teak	Round logs ..	1923–24	1,265	6 6 4	..	..	..
	Do. ..	1926–27	91	5 10 10	2 6 2	3 4 8	..
	Do. ..	1929–30	42	4 0 0	0 8 11	3 7 1	..
	Do. ..	Do.	119	3 8 0	2 1 11	1 6 1	..
Dalbergia latifolia (Rosewood).	Do. ..	1924–25	97	9 1 11	..	..	..
	Squared ..	Do.	37	5 6 6	..	..	..
	Round logs ..	1925–26	3,076	11 11 10	3 4 0	8 7 10	..
	Do. ..	1926–27	1,031	10 15 2	2 10 11	8 4 3	..
	Do. ..	Do.	2,552	11 12 2	2 9 4	9 2 10	..
	Do. ..	Do.	40	15 4 0	2 15 5	12 4 7	..
	Do. ..	1927–28	53	5 7 3	5 8 7	..	0 1 0
	Do. ..	Do.	758	12 1 5	2 14 11	9 2 6	..
	Do. ..	Do.	64	12 7 6	4 0 0	8 7 6	..
	Do. ..	1928–29	625	3 10 11	2 5 9	1 5 2	..
	Do. ..	Do.	164	2 13 3	4 6 11	..	1 9 8
	Do. ..	Do.	344	2 10 8	6 6 9	..	3 12 1
Terminalia tomentosa (Laurelwood).	Squared ..	1923–24	326	5 5 5	..	..	..
	Do. ..	1924–25	711	1 6 2	..	..	..
	Scantlings ..	Do.	2,103	2 9 6	..	..	..
	Round logs ..	1925–26	162	10 4 5	4 5 5	5 15 0	..
	Do. ..	1926–27	364	17 11 5	3 1 3	14 10 2	..
	Do. ..	1927–28	5	8 12 5	6 7 11	2 4 6	..
	Do. ..	1928–29	28	4 9 10	3 15 3	0 10 7	..
	Do. ..	Do.	706	3 14 1	3 5 2	0 8 11	..
	Do. ..	Do.	125	3 10 0	3 2 8	0 7 4	..
	Do.	Do.	83	2 13 3	6 13 6	..	4 0 3
	Do. ..	1929–30	811	2 0 0	0 8 11	1 7 1	..
	Do. ..	Do.	587	2 0 3	0 11 5	1 4 10	..
	Do. ..	Do.	185	2 0 3	1 0 9	0 15 6	..
	Do. ..	Do.	511	3 3 11	1 8 8	1 11 3	..
	Do. ..	Do.	366	3 5 3	1 11 2	1 10 1	..
	Do. ..	Do.	423	2 6 0	2 1 11	0 4 1	..
	Do. ..	Do.	316	3 6 8	1 11 3	1 11 5	..
	Do. ..	Do.	579	4 2 0	1 4 9	2 13 3	..
	Do. ..	Do.	147	5 4 8	2 5 2	2 15 6	..
Adina cordifolia (Haldu).	Do. ..	1927–28	307	2 8 0	15 12 6	..	3 4 6
Albizzia odoratissima (Black Siris).	Do. ..	Do.	38	0 5 4	5 8 5	..	5 3 1
Terminalia paniculata (Kindal).	Do. ..	Do.	259	0 2 3	5 7 5	..	5 5 2
Calophyllum tomentosum (Poon).	Do. ..	Do.	1,637	2 8 0	5 15 1	..	3 7 1
Lagerstrœmia lanceolata (Venteak).	Do. ..	Do.	57	1 7 10	2 7 1	..	0 15 3

143. *Local log sales in the forests.*—Recently, and more especially since the saw mill closed down, local sales of small crooked logs and other timber considered unfit for the Pollachi market have been held. Very small quantities of timber were sold in the forest previous to 1927, but separate records were not kept of these sales. They were included along with the Pollachi sales. Since 1927 larger quantities have been sold in the forest, and experience shows that

these sales meet a demand which is entirely separate from the main Pollachi market. The following statement shows the quantities sold locally and the prices realized :—

Year.	Species.	Form of produce.	Quantity sold.	Price realized per cubic foot.
				RS. A. P.
1927–28	Teak	Round logs	774 c.ft.	0 14 11
	Do.	Spokes and felloes	53 sets	17 11 9 per set.
	Dalbergia latifolia	Round logs	139 c.ft.	0 15 3
	Miscellaneous	Do.	6,429 ,,	0 7 0
1928–29	Teak	Round logs	562 ,,	1 4 7
	Do.	Spokes and felloes	6 sets.	18 0 0 per set.
	Dalbergia latifolia	Round logs	593 c.ft.	2 8 0
	Miscellaneous	Do.	4,313 ,,	0 5 0
1929–30	Teak	Do.	4,563 ,,	1 0 0·5
	Dalbergia latifolia	Do.	650 ,,	0 10 3·1
	Lagerstrœmia lanceolata	Do.	1,151 ,,	0 8 10
	Terminalia paniculata	Do.	671 ,,	0 8 8·5
	Pterocarpus marsupium	Do.	63 ,,	0 7 9·3
	Grewia tiliaefolia	Do.	430 ,,	0 7 3·5
	Terminalia tomentosa	Do.	1,235 ,,	0 7 1·5
	Adina cordifolia	Do.	175 ,,	0 6 1·7
	Miscellaneous	Do.	419 ,,	0 5 11·6

144. *Sawn material.*—The average prices of sawn material converted by the old Mount Stuart saw mill between 1898 and 1903 are given below. Average log prices of the same date are quoted for comparison :—

	Prices per cubic foot.	
	Sawn material.	Logs.
	RS. A. P.	RS. A. P.
Teak	2 12 0	1 10 0
Other species	1 6 0	0 10 0

It was shewn that the average loss incurred by sawing the timber and selling it in the form of planks and scantlings was As. 2–11 per cubic foot.

145. Sawn material from the saw mill, which was installed at Pollachi in 1926 and moved to Top Slip in 1928 was not auctioned, but was sold at the standard depot rates fixed by the Forest Utilization Officer. These rates were the same for the timber depots at Beypore, Olavakkot, Kasaragod, Nanjangud, and Pollachi, and varied for the different classes of produce. The average rates obtained for sawn material sold since 1927 are as follows :—

Species.	1927–28.		1928–29.		1929–30.	
	Quantity in cubic feet.	Average rate per cubic foot.	Quantity in cubic feet.	Average rate per cubic foot.	Quantity in cubic feet.	Average rate per cubic foot.
		RS. A. P.		RS. A. P.		RS. A. P.
Teak	7,304	4 4 0	5,680	2 8 0	5,774	2 9 0
Miscellaneous	9,455	1 14 0	9,218	1 3 7	5,457	1 2 0

The sudden drop in price from Rs. 4–4–0 in 1927–28 to Rs. 2–8–3 in 1928–29 is due to a larger proportion of B-grade material having been sold in the latter year.

146. *Sleeper prices.*—Average prices for sleepers sold at Pollachi in 1927 and 1928 are given below :—

Species.	Size.	Price per sleeper.	Price per cubic foot.
		RS. A. P.	
Teak	Special	..	Rs. 4–8–0 to Rs. 4–12–0.
Do.	Broad gauge	10 8 0	Rs. 3–5–9·2.
Do.	Metre gauge	4 0 0	Rs. 2–10–8.
Do.	Narrow gauge	3 0 0	Rs. 2–6–5.
Terminalia tomentosa	Do.	2 4 0	Rs. 1–14–11·1.

147. *Log prices in Madura.*—Recently a small consignment of logs, mostly of low grades considered to be scarcely worth selling at Pollachi, was sent to Madura to test the market there. The result of this sale was hopeful, as the following figures indicate :—

Quantity consigned = 1,087 cubic feet.

Expenditure.	Total.			Per cubic foot.		
	RS.	A.	P.	RS.	A.	P.
Cost of production at Pollachi	1,200	3	4	1	1	8
Railway freight to Madura—loading and unloading ..	481	1	0	0	7	1
Total cost at Madura ..	1,681	4	4	1	8	9

Of this quantity 479 cubic feet had been sold for Rs. 915–13–3 or Rs. 1–14–7 per cubic foot. Commission to agent at 10 per cent was As. 3–1 per cubic foot. Net rate per cubic foot at Madura Rs. 1–11–6. Hence net profit on timber sold was As. 2–9 per cubic foot.

148. *Log prices at Chalagudi.*—The prices of timber at Chalagudi, at the foot of the Cochin Forest Tramway alter in sympathy with the general fluctuations of the West Coast timber market. The following figures give the prices realized at auctions in 1928–29 :—

Species.	Size.	Range of prices per cubic foot.	Average price per cubic foot.		
			RS.	A.	P.
Teak	Over 4 feet 8 inches midgirth.	From Rs. 2–0–0 to Rs. 3–0–7.	2	12	0
Do.	Under 4 feet 8 inches midgirth.	From Rs. 1–13–7 to Rs. 2–8–10.	2	4	1
Dalbergia latifolia ..	Over 4 feet 8 inches midgirth.	From Rs. 2–15–5 to Rs. 9–5–4.	5	6	0
Diospyros ebenum ..	Do.	....	5	3	0
Terminalia tomentosa.	Do.	....	1	4	9
Xylia xylocarpa ..	Do.	....	1	7	8
Lagerstrœmia lanceolata.	Do.	....	1	1	9

Most of the teak and *Dalbergia latifolia* sold is of very large sizes. There is no sale for the latter species under 4 feet 8 inches midgirth.

149. *Bamboos.*—The prices for bamboo coupes have gone up steadily since the new Top Slip Ghaut Road was opened, as the following figures show :—

Year.	Area sold.	Amount realized.	Year.	Area sold.	Amount realized.
	ACS.	RS.		ACS.	RS.
1925–26	160	705	1928–29	320	2,500
1926–27	262	410	1929–30	951	1,500*
1927–28	400	1,210			

150. *Prices for teak poles from thinnings.*—The following statement shows the number of teak poles sold, and the prices realized in each case :—

Year of sale.	Number of poles sold.	Average price realized.			Remarks.
		RS.	A.	P.	
1925	42	0	9	0	From the second thinning of 1916 plantation.
	18	2	9	0	
	38	1	7	0	
	80	0	5	6	
1930	140	0	7	0	From the second thinning of 1919 plantation.
	955	0	4	0	
1928–29	5,062	0	1	9	From first thinnings.
1929–30	2,056	0	1	11	Do.

---

* The bamboos in this coupe had flowered, hence the low price offered.

151. *Minor forest produce.*—Hitherto minor forest produce has not been sold within the working plan area. The following statement shows the approximate rates paid by Cochin contractors to the jungle tribes who collect the produce. Payment is sometimes made in rice for which purpose the rate of 5 measures to the rupee is adopted. Payment is also occasionally made in opium in the form of small balls valued at 2 annas.

152—*List of Minor forest products collected in Tunacadavu Reserve.*

Latin name.	Vernacular name.	Form of produce.	Rate paid for collection.			
			RS.	A.	P.	
Acacia concinna	Seekai	Soapnut	1	8	0	per maund.
Elettarea cardamomum	Yelam	Cardamoms	0	9	0	per measure.
Curcuma longa	Manjal	Turmeric-green	0	12	0	per maund.
Zingiber officinale	Inji	Ginger-green	0	10	0	,,
Ailanthus malabarica	Mattipal	Gum-resin	0	4	0	per small bamboo tube.
Vateria indica	Kungiliam ..	White dammer	2	8	0	per maund.
Canarium strictus	Karukungiliam ..	Black dammer	2	0	0	,,
Piper nigra	Milagu	Pepper-green	0	4	0	per measure.
Do.	Do.	Pepper-dry	0	8	0	,,
Calamus viminalis	Pirambu ..	Canes stout with roots, 3 cubits long.	3	0	0	per 100.
Do.	Do. ..	Canes as thick as finger, 3 cubits long.	2	8	0	,,
Do.	Do. ..	Canes thin, 3 cubits long ..	1	4	0	,,
....	Tēn	Honey	0	6	0	per measure.
....	Melugu	Wax in a cake 2″ thick and 18″ in circumference beaten flat.	0	4	0	per cake.
....	..	Deer horns	0	4	0	each.

In all cases the measure is the small Coimbatore measure, which is half the standard Madras measure.

CHAPTER IV—STAFF AND LABOUR SUPPLY.

SECTION 1.—STAFF.

153. The following table shows the present strength of the executive and clerical establishments of Tunacadavu range :—

A. Executive Establishment.

One ranger, I grade.
Two rangers, II grade.
One Assistant Veterinary Inspector.
One forester, I grade.
One forester, III grade.
Three foresters, IV grade.
Three foresters, V grade.
One forest guard, I grade.
One forest guard, II grade.
One forest guard, III grade.
Six forest guards, IV grade.
One jamadar.*
Two depot-keepers.*
One road-roller driver.*
One telephone linesman.*
Two depot-watchers.*

B. Office Establishment.

One range clerk.
One assistant range clerk.
One temporary range clerk.*
One range peon.
Two tapal watchers.*
One peon to Assistant Veterinary Inspector.*
One commercial accountant (in District Forest office).

There are thus 36 sanctioned posts, of which 25 are permanent and 11 are temporary. (Temporary posts are marked *.)

154. The present staff was adequate for the working of the forest under Mr. Wood's Working plan, and no difficulty was felt except in the fever season, when, in bad years, a shortage of staff was experienced.

155. A number of the foresters are Kadirs and Malsars, who have been recruited from the local jungle tribes and it is found that these men are only useful for certain manual works, as they are not literate and have not got the intelligence of educated men. They should be replaced by educated men from the plains as soon as possible.

156. The two depot-keepers are paid at the rate of Rs. 35 per month. It would be more satisfactory if one were paid at the rate of Rs. 40 and the other Rs. 30 per month. The senior man would be made responsible for the condition of the depots. It appears illogical, however, that a depot-keeper who combines the duties of a forester and a clerk should be deprived of all allowances and have no chance of earning increment, when clerks get local (unhealthy tract) allowance and foresters get local allowance and fixed travelling allowance. Depot-keepers undoubtedly deserve local allowance more richly than do clerks who are not exposed to the wet and cold of the monsoon and the heat of the hot weather sun.

157. Under the present working plan there will be a considerable increase of work, and it will be necessary to increase the number of foresters. If the illiterate Kadir and Malsar foresters are all replaced by good educated plainsmen probably only one or perhaps two more men will be required, but if they are retained, then three or four more good foresters will be necessary. It is essential to have sufficient men in all ranks to form a sick reserve during the fever season when the important works of fire-protection and of preparing the regeneration areas are in progress.

SECTION 2.—LABOUR SUPPLY.

158. The local Kadirs and Malsars are not nearly sufficient for all the works in the range, and outside labour has to be imported. The labour shortage is severely felt, and it is this which restricts the programme of works prescribed in this working plan. The following statement shows the approximate numbers of coolies usually available locally :—

		Number available.	Wages paid.	Remarks.
			ANNAS.	
Kadirs	Men	24	8	
	Women ..	8–10	4½	
	Children ..	8–10	4½	
Anapadi Malsars	Men	40	8	
	Women ..	25	4½	
	Children ..	20	4½	
Mandipatti Malsars	Men ..	30	10	All axemen.
Kachithodu Kadirs	Men	10	10	Axemen.

Total—

Men	104
Women	34
Children	30

159. In 1930 some wandering Hill Malsars were persuaded to settle in the Mount Stuart forests, and were given land to cultivate on which they had to raise ponam crops of teak at the same time. The local labour force has thus been increased by 44 men and 32 women coolies. They are paid at the same rate as the other local coolies.

160. All local coolies whose wages are less than Rs. 15 per month get a concessional rate for rice at the Top Slip bazaar.

161. Details of imported labour are as follows :—

Type of coolie.	Locality.	Wages paid.	Remarks.
		RS. A.	
Axemen	Palghat, Mannarghat, etc. ..	1 0	Usually employed on piecework.
Sawyers	Tattamangalam, Palghat ..	..	Piecework.
Road coolies, earthwork, masons, etc.	Wodders from Vettaikaranputtur, Anaimalai, etc. (available in large numbers).	1 0 0 8	Men. Women and boys usually on piecework, also employed for mamuti weeding in plantations.
General cutting of jungle line clearing, weeding, etc.	Sircarpatti Malsars	0 10	About 25 men available.
Do.	Chucklers from Vettaikaranputtur, Anaimalai.	0 10	Available in large numbers.

CHAPTER V.—PAST SYSTEMS OF MANAGEMENT.

SECTION 1.—GENERAL HISTORY OF THE FOREST.

162. *Sources of information.*—The past history of the forest has been taken chiefly from Mr. Wood's working plan. The information given therein has been re-arranged, and has been supplemented by references to old inspection memoranda, administration reports, the "Manual of the Coimbatore district," and other sources.

163. *Division into periods.*—The history of the forest falls naturally into three periods, namely,—

A. Period previous to Mr. Porter's working plan, i.e., before 1885.
B. Period of Mr. Porter's working plan, 1885 to 1918.
C. Period of Mr. Wood's working plan, 1918 to 1930.

A. Period previous to Mr. Porter's working plan before 1885.

164. In early years, certainly earlier than 1839, considerable quantities of teak were extracted from the forests of Malabar, Travancore, Cochin and Kanara for the use of the Bombay dockyard where men of war were constructed for the Indian Navy. Of the forests indented on it is certain that the Tekkadi leased forest, then called Kollengode, Agomalay or Anamalai forest, was one. The timber in the form of large planks was brought to the coast by contractors, who obtained leases from the Nambidi of Kollengode, and was there taken over by an officer of the Indian Navy known as the "Timber agent".

165. Government being of the opinion that better arrangements could be made, and better results obtained, Major F. C. Cotton, R.E., Civil Engineer, Coimbatore, was called upon to investigate and report. He reported, in a letter dated 9th July 1849, that "the Kollengode and Anamalai forests are one and the same,"and that "it is from this forest that contractors had been supplying timber in the past." "The only difference is", he reported, "that the Raja's finest trees have all been cut, while a great extent of the forest belonging to the British Government is still untouched."

166. This statement was based on the belief that the Tekkadi forest belonged to the British Government, and lay in Coimbatore district, and that the Tekkadi river was the eastern limit of the Nambidi of Kollengode's territory. After an enquiry, the Government recognized the ownership of the Nambidi in their Order No. 883 of 1st September 1850.

167. Major Cotton, in his report referred to above, emphasized the fact that there were large trees available in great number, and made proposals for girdling them and converting them into planks using the saw as much as possible. Actually however saws were not used, but the trees were converted into planks by splitting with wedges and trimming with the axe.

168. The idea then prevalent of the enormous resources of these forests was thus expressed by the Collector of Coimbatore in 1846—

> The teak forests of this district are immense and will admit of the supply of timber *to any extent* of good and unexceptional quality.

Major Cotton's proposals did not altogether savour of strict conservancy. His main idea seems to have been to utilize what was considered the almost unlimited wealth of the forest to the best advantage. His theory was that teak cannot grow where teak has grown before and that a rotation of crop was necessary—a very convenient theory upon which to base proposals for exploitation.

169. In 1848, owing to Major Cotton's recommendations, Captain J. Michael of the Madras Native Infantry was deputed for eight months to investigate the teak forests. Eventually he was appointed a "Superintendent of the Anamalai Forests" to supervise their working, mainly with a view to meeting the demand for the Bombay dockyard. Captain Michael was placed under the control of the Civil Engineer, an arrangement which continued up to 1853, when the control passed to the Collector of Coimbatore. Lieutenant (later Captain) Douglas Hamilton worked along with Captain Michael until the Madras Forest Department was formed under Doctor Cleghorn in 1856.

170. In 1848 the Bombay Government proposed that the Anamalai and Walayar forests, together with others in Malabar and Kanara, should be managed by Dr. A. Gibson, who had been appointed Conservator in that Presidency in 1846. This proposal found no favour with the Government of Madras, and was also vetoed by the Government of India (vide Order No. 1016, Home Department, dated 18th November 1848).

171. The ownership of the Nambidi having been admitted, Captain Michael, supported by Major Cotton, proposed that the Tekkadi forests should be leased from the owner. This proposal was met with approval, and a lease for a term of six years from the 1st January 1851 was entered upon.

172. Payments of stump fees at the rate of Rs. 5 per teak tree felled were to be made by the Government. The Nambidi was given an advance of Rs. 7,500 for 1,500 trees, and no further payments were to be made until this advance had been cleared off. The lease was for teak only, all other timber and produce remaining at the disposal of the Nambidi. The lease was saddled with the balance of current contracts with four private contractors, which did not expire until the middle of 1852.

173. Captain Michael had started work in the Sichali valley where 1,500 trees were girdled in 1848 and felled in 1850.

174. During the first years after the forest was leased by Government it was worked almost entirely to satisfy the demands of the Bombay dockyard, and nothing was done in the direction of conservancy and improvement beyond the prevention of theft.

175. In 1850 Captain Michael constructed a cart-road 6½ miles long from Top Slip to Sichali (Michael's trace) at a cost of Rs. 4,139, to facilitate timber extraction. Only the last mile of this lies in the leased forest. Timber was carted along this road to Top Slip whence it was skidded down the ghaut to Adivaram. Thence the timber for the Bombay dockyard was carted for about 37 miles to the Palghat river at a point a little above the town of that name, whence it was floated for 70 miles to the coast at Ponnani. At the Ponnani depot it was taken over by the Government timber agent.

176. Considerable quantities of timber were also sent to the Madras Arsenal. This latter timber was carted from Adivaram via Pollachi, Udiyar and Kangayam to Vangal, a village on the right bank of the Cauvery a little above Karur—a distance of 120 miles. Thence it was floated down the Cauvery to the mouth of the Coleroon where it was loaded on coasting vessels for delivery at Madras.

177. In 1859, Captain Michael traced a ghaut road to replace the slip which was very difficult to maintain in efficient order. This road was not constructed until 1868. It remained in use until 1924.

178. At the close of 1856, a separate Forest department was created with the appointment of Dr. H. F. Cleghorn, M.D., Assistant Surgeon, as the first Conservator of Forests in the Madras Presidency. Captain Michael continued working the Anamalai forests under his orders.

179. On the expiry of the first lease, a second lease for a period of 99 years was entered into, dating from the 1st of January 1857. There were considerable changes in the new lease, the most important being—

(*a*) That the British Government was to have complete control of the timber and could lay down such rules for conservancy as to them shall seem fit. The "customary rights" of hill tribes to cut junglewood for their own proper use was not to be interfered with, and the janmi reserved to himself the usual rights to honey, ivory, cardamoms and such hill produce.

(*b*) Stump fees at the following rates were to be paid for natural trees felled :—

	RS.	A.		RS.	A.
Teak	6	0	Arjuni	3	0
"Blackwood"	6	0	Agil		
Vengai	3	8	Irul		
Karumarudu	3	8	Venteak	2	8
			Pillamaradu		

No stump fees were leviable on planted trees cut as saplings, or on any felled in thinnings, clearing roads, bridging, building huts, or other conservancy purposes, or on any kind of trees not included in the above list. Saplings were defined as young trees less than 30 inches in circumference at a height of 6 feet above the ground.

(*c*) The janmi was not to be called upon to pay any share of the cost of management, nor could he claim any share or fee, other than specified above.

(*d*) The account of trees felled, and the stump fees thereon was to be made up annually and an authenticated statement presented to the lessor.

(*e*) An advance on account of stump fees of Rs. 30,000 free of interest was made to the janmi, and no money payments were to be made until this advance had been wiped off.

(*f*) Five outstanding contracts, one for 156½ cart-loads of teakwood, three for an aggregate of 491 cart-loads of blackwood, and one for 400 cart-loads of junglewood, were recognized and had to be satisfied by the lessee. The recognition of the contract for teakwood is curious in view of the clause in the original lease which precluded new contracts for that timber being granted. All five contracts had expired by the 12th October 1868.

180. This new lease was preferable to the old one, but it was soon apparent that it was unsatisfactory. It is obvious that, with a limited lease, no improvement of the forest could be undertaken. Moreover the system of payment by stump fees was found clumsy and irksome. Nevertheless the lease remained in force for nineteen years and it was not until 1887 that a revised lease was brought about.

181. In 1862–63, the Indian Navy ceased to construct vessels in Bombay and the demand for Anamalai teak for that port practically ceased, though considerable quantities of planks were sent to Bombay as late as 1867.

182. Timber was still floated to Ponnani, however until 1870 after which rail transport superseded water carriage. Mr. Popert in an inspection report many years later says, in connexion with the supply of timber to the Bombay dockyard, that "financially, as far as the forest revenue is concerned, the work cannot be said to have been a success, and from a forester's point of view the forests were being simply ruined."

183. Captain Beddome, then Conservator of Forests, proposed to reserve the Anamalai teak for the English Navy on the grounds of its superiority to Burma teak. Nothing appears to have come of this suggestion, though it was submitted to the admiralty. It has been stated however that the H. M. T. S. "Cornwell", now a training ship for the navy moored off Purfleet on the Thames was built of Mount Stuart teak, but it has not been possible to verify this.

184. During this second lease very large quantities of timber were extracted, and in 1866 Captain Beddome reported that there was no large teak left, and that the forest required a complete rest for 15 to 20 years. Fellings however were continued until 1879–80 when they were stopped to give the forest a rest until 1885 when extraction was resumed.

185. In 1879–80 the North and South Coimbatore divisions were amalgamated into a single Deputy Conservator's charge (now four divisions—1930), the Anamalai forests being reduced to a range in charge of a Sub-Assistant Conservator. In the same year the Tunacadavu reserve was demarcated, but it was not finally notified as a reserved forest until 1883, the Tekkadi leased forest being included within the boundaries described. The South Coimbatore division again became a separate division in 1885, and included the Mettupalaiyam and Bolampatti ranges until 1909 when the two latter ranges were separated off to form the new Central Coimbatore division.

186. Mr. J. S. Gamble, after visiting the forest in 1885, made certain suggestions and laid stress on the necessity for some regular plan of working. As a result Mr. Porter undertook the preparation of a working plan in 1885–86 which appears to have been put into operation at once.

B. Period of Mr. Porter's Working Plan, 1886 *to* 1918.

187. Mr. Porter's working plan (which is dealt with more fully under the section "Past systems of Management and their results," paragraphs 242 to 250) inaugurated another period of intensive exploitation, the only difference being that the annual yield was regulated to a certain extent so as to maintain a regular outturn for the first period of the rotation, namely, the thirty years from 1886 to 1915. Actually the possibility prescribed in the working plan was not nearly worked up to partly because it was found that the enumeration upon which the calculations were based was insufficiently accurate, and also because fellings soon became subservient to the working of the tram-line and the saw mill.

188. The most important event of this period of the history of the forest was the drawing up and ratification of a third lease with the Nambidi of Kollengode in 1887. This lease is still in force to-day, and was the result mainly of the representations and energy of Mr. H. J. Porter who was District Forest Officer at that time.

189. The unexpired balance of 80 years of the existing lease was reaffirmed, but the lessor now agreed to the "perpetual renewal or extension of the same for like periods." This clause at once changed the whole aspect, and for the first time the Forest department was in a position to contemplate the introduction of conservancy on proper silvicultural lines.

190. The most important clauses of the new lease are given below :—

(i) All rights were extinguished in the land except the following :—

(*a*) Right of way for the janmi's timber and produce along the cart-track from Tellikal through the leased forest to the Gudaravalli forest, and the branch track which crosses the Tekkadi river, and the right to use the timber slip down the Ayyasamimudi ridge.

(*b*) Right to store timber at the bottom of the said slip.

(*c*) Right to all elephants captured accidentally or otherwise. (This clause has since been altered.)

(ii) The British Government was debarred from taking any steps to capture elephants and to quarry or mine for precious metals or stones (since altered in respect of elephants only).

(iii) The payment of stump fees was abolished in favour of fixed rental.

(iv) Of the advance of Rs. 30,000 made in 1867, only Rs. 13,661 had been recovered by adjustment of stump fees when the revised lease was executed. A further advance of Rs. 75,000 was now made bringing the total up to Rs. 91,339. This debt was to be liquidated by adjustment of part of the annual rental during the first thirty-seven years.

(v) The rental of the first eighty years was fixed at Rs. 5,000 per annum, the actual payments for the first 36 years being Rs. 2,500 and for the thirty-seventh Rs. 1,339 and thereafter the full rent of Rs. 5,000, the payment to be made in equal half-yearly instalments. The whole debt was paid off by April 1924.

(vi) Should the British Government desire to renew the lease, a renewal fee of Rs. 5,000 for the first term, Rs. 6,000 for the second term, and Rs. 7,000 for the third and every subsequent term will be payable.

(vii) The annual rental for the first extension is fixed at Rs. 5,000, Rs. 7,500 for the second, and Rs. 10,000 for the third and all subsequent extensions.

(viii) Interest at the rate of 1 per cent per mensem will be paid after the expiry of one month from due dates of payment, i.e., 1st April and 1st October every year. If payment falls in arrears for over three calendar months the lessor shall be at liberty to determine the lease absolutely.

191. Under this lease, Government became to all intents and purposes the assured managers of the forest perpetually, and from this time forward the questions of conservancy and regeneration began to be considered seriously, but although various experiments were tried in order to obtain both natural and artificial regeneration, no substantial results were achieved. Mr. Porter's scheme remained unaltered until 1915. It only provided for the extraction of the best species from the Tekkadi leased forest, and no regulated scheme to assist regeneration or to improve the forest was added.

192. The main events during the period of Mr. Porter's plan were the construction of the ghaut road in 1868 and the completion of the tram-line from Sungam to Top Slip in 1891. These are described in Chapter III, section 3.

193. In 1898, a saw mill worked by water power was installed by Mr. Gass on the Tunacadavu river below Mount Stuart, for the purpose of converting into planks and scantlings timber of miscellanous species other than teak, which at that time did not sell profitably in log form. It was hoped that, when converted, they would find a remunerative market in Coimbatore. After the saw mill had been working for a very short while, however, the original reason for its introduction was lost sight of, and teak logs were sawn up to supply special orders for the Public Works Department and other customers. Within less than two years the saw mill was being supplied with specially selected logs, a large proportion of which were teak.

194. In 1903, an investigation into the working of the saw mill revealed that it was making a considerable loss each year. The average cost of conversion per cubic foot, including interest and depreciation charges, worked out to Re. 1 per cubic foot. The wastage in conversion was 46·2 per cent and the prices realized for logs and for sawn material were at that time Rs. 1–9–8 and Rs. 2–12–0 respectively for teak and Re. 0–12–8 and Rs. 1–6–0 respectively for miscellaneous species. The loss shown by the saw mill since it was first installed, if the value of the selected logs entering the mill is considered was as follows :—

Year.	Amount.		
	RS.	A.	P.
1898–99	2,752	1	10
1899–1900	2,595	7	10
1900–01	13,004	6	5
1901–02	7,767	5	1
1902–03	14,849	6	1
Total loss on five years' working	40,968	11	3

195. It was argued in defence of the saw mill that it was cutting up and putting on the market timber which would otherwise not be extracted at all owing to the limited facilities for carting then available but this argument was shown to be fallacious since (*a*) the very best timber which sold most profitably in the log was being supplied to the mill, and (*b*) carting facilities could easily have been increased by improving the ghaut road at a cost of only a fraction of the expenditure on the mill.

196. One of the chief reasons why the saw mill failed to pay was the low annual outturn. Mr. Gass estimated that the outturn should have been 30,000 cubic feet of sawn material per annum. Actually the average annual outturn was only 9,771 cubic feet and the maximum attained in 1903–04 was 20,394 cubic feet. The main cause for this low output was difficulty experienced with the saw and the pelton wheel, the jet of which was continually becoming worn by particles of grit in the water. The power developed was insufficient to work the main breakdown saw to its full capacity. Shortage of water in the hot weather also contributed to the inefficiency of the mill. In 1902 in an inspection report Mr. Gass remarks that " I made an attempt to cut a log of over 12 inches in diameter on the large circular saw, but it was not a success, and I have no doubt the best policy is not to attempt greater thickness than 8 inches."

197. In July 1904, the Board of Revenue ordered that the sawing of teak in the saw mill was to be discontinued. Owing to the higher percentage of wastage, and the lower prices obtained for scantlings and planks of miscellaneous species, an even greater loss was experienced. The saw mill continued to work until January 1909 when the dam which supplied the water to the mill was swept away by an exceptionally heavy flood thus precipitating the closure of the mill, which had been pending for some time.

198. A wire ropeway was also constructed by Mr. Gass in 1901 to convey the sawn material from the head of the tramway at Top Slip to Adivaram, so as to relieve the congestion of carting down the ghaut road, but this also ran at a loss and was unsatisfactory in many respects. The total capital cost of the ropeway was Rs. 15,089. It is probable that it might have paid its way if the saw mill had been worked to its full capacity of 30,000 cubic feet per annum. As it was, the ropeway only conveyed some 10,000 cubic feet of sawn material annually. It was suggested by Mr. Gass that logs should be hand-sawn in the forest to supplement the quantities of sawn material, so as to keep the ropeway more fully employed, but this suggestion was not given effect to. The loss incurred by the ropeway, as compared with carting by the ghaut road, was stated to be about Rs. 1,100 per annum. It was designed to transport sawn lumber only, and its maximum load was only 800 pounds. The ropeway went out of use in 1909 when the saw mill was closed down.

199. The quantities of timber extracted under Mr. Porter's plan fell far short of the amounts anticipated. Nevertheless in 1915 there was so much felled timber lying unextracted in the forest that fellings were suspended for three years, during which period a new working plan was prepared by Mr. Wood.

200. The British portion of the forest, which lies east of the Malabar boundary and north of the Vengolimalai-Umayamalai ridge was given a rest from 1885 onwards. In 1909 Mr. Arbuthnot prepared a working plan for this portion of this forest, which was sanctioned in B.P. Forest No. 125, dated 5th May 1911. The plan prescribed certain sylvicultural operations without any fellings. These were carried out to a certain extent, but owing to lack of control the results of the treatment have mostly been lost. Operations under this plan are dealt with more fully under section 2 of this chapter. The work ceased after 1915 because all available labour was taken by the working plan party and the Forest Engineer.

201. In July 1916, a working plan party under Mr. C. C. Wilson commenced work, and in October 1916 Mr. Wilson completed his reconnaissance report, in which he recommended that the area be divided into four working circles, viz :—

(1) *The Karianshola Working Circle*, which, as an evergreen forest and the source of many streams was not to be worked.

(2) *The Bamboo Working Circle.*—Bamboo was considered a nuisance in these forests and the proposals contemplated leasing the area out for clear-felling to bamboo contractors and replacing that growth by concentrated regeneration of teak or other timber species.

(3) *The Ulandi Timber Working Circle.*—Mr. Wilson suggested an enumeration survey of this part of the forest after which, in view of the value of the timber that might be found in it, the most paying method of exploiting the forest was to be investigated.

(4) *The Mount Stuart Timber Working Circle.*—This consisted of the main block of deciduous forest, and included the Tekkadi leased forest as well as the British forest east of Mount Stuart. The area is about 15,000 acres. It was to be worked by selection fellings of teak and other saleable species, and under a scheme of clear-fellings with natural regeneration, by which the whole forest was to be restocked with teak at the rate of 100 acres per year in 150 years, which was taken as the probable rotation for teak in this locality. Under Mr. Wilson's scheme the whole forest was to be divided into three periodic blocks of 5,000 acres each, and working was prescribed for the first period of fifty years as follows :

Block No. I—reserved for clear-felling and natural regeneration at the rate of 100 acres per annum.

Block No. II—was to be given a complete rest, as it was the portion of the forest most recently worked over.

Block No. III—to be worked for selection felling at 100 acres per annum.

202. Mr. Wilson also prescribed fire-protection and an annual scheme of Lantana eradication.

203. The criticisms offered to these proposals were that natural regeneration was too uncertain for the purpose of establishing an area under teak after clear-fellings, and that, as was shown by subsequent enumerations, there was a considerable quantity of mature timber standing in periodic block II, and consequently there would be a loss of revenue if no fellings were done in block II during the first fifty years.

204. Mr. Wilson went on military duty in October 1916, with the Central India Horse, and Mr. Wood, then the District Forest Officer, took over the preparation of the working plan. He agreed generally with Mr. Wilson's proposals, retaining the division into three periodic blocks, but considered that selection fellings should not be confined to block III alone. He also advocated the substitution of concentrated artificial regeneration of teak at 25 acres per annum for Mr. Wilson's natural regeneration of 100 acres annually.

205. The preparation of Mr. Wood's working plan was completed by 1918. A 50 per cent enumeration over the whole of the forest including Ulandi block was carried out, and the numbers of trees and volume of the growing stock was worked out for each of Mr. Porter's compartments, and new coupes were laid out covering the whole area in fifty years. The working plan prescribed that each coupe was to be worked by the selection method, trees, being felled down to a 7-foot girth limit, and that 25 acres of the best locality within each coupe was to be clear-felled, burnt over and regenerated with teak by dibbling. A greater area could be attempted if sufficient labour were available. The working plan also prescribed fire protection and Lantana eradication, with broadcast sowings of teak seed in the areas eradicated. The plan was sanctioned in B.P. Forest No. 10, dated 10th March 1919, and came into force on 1st April 1919.

206. During the period of preparation of the working plan between 1916 and 1919 the large quantities of timber that were lying felled in the forest, and which for want of transport facilities had not been extracted, were removed to Pollachi depot.

C. Period of Mr. Wood's Working Plan, 1919 to 1930.

207. Felling began again under this plan in 1919. The prescribed order of working the coupes was departed from right from the start. They had been laid out on the assumption that the steam tramway system proposed by Mr. Bright, which was to have its exit by means of a series of reversing stations below Ayyasamimudi into the Gudaravalli valley, would be constructed. The scheme was, however, fortunately turned down by Government on account of the high prices of materials after the war. Fellings were arranged therefore to proceed within easy reach of the existing bullock tramway from Sungam to Top Slip, and all timber was extracted by that route or by the new Top Slip-Anaipadi road which was opened in 1926.

208. The Mount Stuart forests were brought under commercial accounts in May 1924, and are still commercialized. It is however hoped that, owing to the recognition of the unsuitability of applying ordinary commercial principles and rates of interest to a subject like forestry which is largely protective, and which deals with longer periods of time than are encountered in ordinary business, the usual departmental system of accounts will soon be reverted to.

209. In 1927, the headquarters of the range were moved from Mount Stuart to Top Slip on account of the unhealthiness of the former settlement. Full details of the incidents leading to this move are given in section 3 of this chapter.

210. The stocks in Pollachi depot were accumulating faster than the timber was being sold, and in 1926 the stock was 178,410 cubic feet. Many of the logs were over four years old, and there was a considerable amount of degrade. There is little doubt that this enormous accumulation was due to the District Forest Officers at the time trying to keep up the prices by refusing low bids at a time when the general timber market was depressed. In order to clear off this accumulation a semi-portable saw mill was installed in June 1926 at a cost of Rs. 35,408–3–1 and started regular work in July 1926. The production cost of the mill including all overheads was, under the commercial accounts then in force Rs. 1–0–5·77 per cubic foot for 1926–27. During the major portion of the next year, 1927–28, the mill continued work in Pollachi, and was moved to Top slip in February 1928. The cost of production for 1927-28 was, according to the commercial audit report, Rs. 2–1–7·28 per cubic foot. The quantity of logs sawn in 1926–27 was 56,688 cubic feet and in 1927–28 was 62,806 cubic feet giving a total of 119,494 cubic feet. The stock in the depot at the end of March 1928 was 460 logs of 13,702 cubic feet. The mill was employed in cutting up a large stock of badly deteriorated logs, but as it was expected to pay for them at the current rates for fresh timber, it failed to show a profit. These rates were subsequently reduced by the Chief Conservator to Re. 1 for teak and *Dalbergia latifolia*, and 8 annas for other species, but it is doubtful whether much of the timber taken in was worth even this figure.

211. The mill was removed to Top Slip in February 1928 at a cost of Rs. 12,703–9–11, the idea being to use it for cutting up the small crooked logs which could not be sold at a profit in Pollachi. It was soon evident that the mill could not be worked profitably unless a better class of logs was supplied. The logs were graded into A, B, C and D classes. A and B class logs were intended to be sent to Pollachi for sale in the log, C class logs were to be supplied to the mill, being considered unfit for sending to Pollachi, and D class logs were considered too poor for any of the above purposes, and were sold when possible at the roadside. When it was found that the mill could not pay on C class logs alone, the B class logs were subdivided into B-i and B-ii logs, and the latter were supplied to the mill. This was as it were, the thin edge of the wedge, and whenever any special orders for the mill were received, B-i logs and sometimes even A logs were requisitioned. A and B logs could be sold in Pollachi at a considerable profit, but when converted into scantling and stock sizes they showed a heavy loss. The production cost of the mill at Top Slip was Rs. 2–4–10·79 per cubic foot. A survey of its performance after eighteen months' work disclosed that it could not show a profit even if the timber supplied were valued at only the cost of extraction, say 6 annas per cubic foot. The consumption during 1928–29 was 38,543 cubic feet and the outturn 13,408 cubic feet giving a conversion percentage of 34·87 per cent. The causes for its failure were chiefly due to the low outturn and the consequently high overhead charges. This was partly due to the mill being underpowered, so that the large breakdown circular saw could not keep the re-saws and the bolter fully engaged, and partly on account of the impossibility of retaining the trained staff on account of sickness. Even supposing that these difficulties could have been overcome, and that the mill could have dealt with the whole of the outturn of the B-ii and C class logs, the quantity sawn would not have been sufficient to make the mill pay. It is an almost exact repetition of the history of the old Mount Stuart saw mill. The mill was closed down on 31st December 1929, and is at the time of writing awaiting a purchaser. Since the mill has been closed, the District Forest Officer has sold in the forest 2,000 to 3,000 cubic feet monthly of the type of timber that was being sent to the mill and has obtained satisfactory prices. Experience shows that the market for such small timber is entirely separate from the Pollachi market, and the demand is expected to continue.

212. The Pollachi depot was transferred to the Utilization division, and was under the control of the Forest Utilization Officer from 1st April 1927. It may be advisable to shift the depot to Anamalai farm when the new Pollachi-Palghat line, now under construction, is opened, as there will be a station within reach of the farm.

213. Work under Mr. Wood's working plan did not follow the prescriptions in several respects. The areas clear felled in each year's selection felling coupe greatly exceeded 25 acres per annum, and in one year 251 acres were regenerated. In 1929 the yield from 151 acres of clear-fellings was so great that no selection fellings at all were done. The prescriptions for fire-protection were departed from after three years, owing to insufficiency of labour. All the labour that should have been employed on fire-protection was absorbed by the very large areas regenerated annually.

214. Lantana eradication was attempted but soon proved to be ineffectual and too expensive. These points are dealt with more fully in section 3.

215. *Elephant-capturing in the Tekkadi leased forest.*—As previously stated, the lease of 1887 did not permit the lessee to capture elephants within the Tekkadi leased forest. It was found however that elephants became so numerous, and did so much damage to the teak regeneration areas that the question of revising this clause of the agreement was raised, and the advantages of a system of elephant-capturing in which the value of all elephants caught was shared by the lessor and the lessee were pointed out. Accordingly, on the 1st of July 1921 an agreement was made permitting Government to capture elephants within the leased forest. All elephants caught were valued by the lessee, but if the Raja of Kollengode did not agree to the valuation, he could inspect the animal and fix his own valuation. The lessee had first option of retaining the elephant, in which case half the value was to be paid to the Raja. If the lessee did not wish to retain the elephant, the Raja had the option of keeping it, paying half the value to Government. If neither wished to retain the animal, it was to be sold in auction and the proceeds divided equally between the lessor and the lessee. Under this agreement the lessee had to bear all the costs of capturing and keeping the elephant until it was trained.

216. This agreement which expired in 1926 was renewed for a further period of three years up to the first of July 1929, but it was found that the lessee who had all the expense and risk of capturing and training the elephants, made very little profit, and occasionally suffered a loss on the elephant capturing operations in the leased forest. Therefore, from 1st July 1929 to 31st March 1930 a provisional agreement was entered into on similar terms to the first agreement, but with the difference that Rs. 250 was to be deducted from or added to the value of the elephant according as the lessee or lessor respectively wished to retain it. If the elephant was sold in public auction, the sum of Rs. 250 was to be deducted from the proceeds and paid to the lessee, and the remainder equally divided between the lessor and the lessee. In this way, the cost of capturing and training, which was estimated at about Rs. 250 for each elephant was divided equally between the Raja of Kollengode and Government.

History of the Ulandi Block.

217. Prior to 1906 no work was done in the Ulandi block as far as is known, on account of its inaccessibility.

218. In 1906 a working plan, known as the Varigali Valley Working Plan was made for exploiting this area, as the construction of the road over the Vengoli-Umayamalai ridge was contemplated. The area was divided into 10 coupes of about 250 acres each ; 439 trees were to be felled annually. The first coupe which yielded 47,034 cubic feet was felled between November 1911 and March 1913. Unfortunately the construction of the road by which this timber was to have been exported was only commenced in the year 1912, and after making a few miles from Top Slip, it was abandoned on the ground that the trace was a bad one. Thirty-four thousand five hundred and thirty-five cubic feet of the felled timber was sold for Rs. 16,293–2–0 to a Palghat contractor who did not pay for it until 1918. In the meanwhile part of coupe IX under the same plan was worked departmentally, yielding 2,885 cubic feet of teak and *Dalbergia latifolia* which the same contractor, bought for Rs. 2,885. He also took 2,576

cubic feet of teak and *Dalbergia latifolia* obtained from the departmental clearing of the Cochin boundary for Rs. 1,250 in the same year. He exported all this timber down the Cochin tramway.

219. In order to compensate the contractor for loss incurred in the above contracts, he was given a further contract for standing timber at Palakadavu. The exact locality is not stated, but it appears to have been an area of about 125 acres on the north side of the Periyar adjoining the Cochin boundary. He was permitted to remove 30,000 cubic feet of teak from 174 marked trees at a seigniorage of Re. 1 per cubic foot. Actually he only felled 111 of these trees which yielded 28,922 cubic feet, showing that the original estimate of the volume of each tree was too low. The average volume per tree was 260 cubic feet while one of the largest trees felled yielded no less than 1,099 cubic feet. All the 174 trees were marked within an area of 125 acres.

220. The contractor finished this extraction by 1922, since when no further exploitation has been done in the Ulandi or Palakadavu blocks.

221. The questions of sylviculture and conservancy have been almost entirely neglected in the Ulandi section. The working plan of 1906 prescribed certain operations to ensure reproduction of teak and *Dalbergia latifolia,* and laid down that, if necessary, artificial reproduction should be resorted to. None of these operations had been carried out up to 1916, when an experiment was made by Mr. Wood in concentrated artificial regeneration of teak. Plots were selected, 2 by 2 chains in teak forest, and were cleared, and all material removed from the plots without any burn. Teak was dibbled 3 feet by 3 feet and the plots very carefully weeded, at a cost of Rs. 12–8–0 per acre during the first year. The plants were stated to be beyond the danger from weeds at the end of the first year, and nothing was spent on weeding during the second year, though the local forest guards kept the plots clean. The experiment showed that teak could be successfully raised by clearing, dibbling and proper weeding, but it also indicated that in plots only 2 chains square an undue proportion of the area received drip from the surrounding trees. These areas were subsequently entirely neglected, and were almost completely wiped out by successive forest fires.

Preparation of the present Working Plan.

222. In 1926 a 50 per cent enumeration and topographical survey of Karian Shola was carried out by the staff of the logging Engineering division.

223. In September 1927, at a meeting of the Chief Conservator, Chief Forest Engineer, Conservator of Forests, Fifth Circle, Conservator of Forests, Working Plans Circle, District Forest Officer, and others, the question of the revision of the working plan made by Mr. Wood was discussed, and the following decisions were arrived at :—

(1) The whole area was to be mapped on a large scale, and a 100 per cent enumeration carried out over the whole of the deciduous forest area, including Ulandi, by the method of topographical strip enumeration surveys introduced by the Chief Forest Engineer.

(2) All areas undoubtedly fit for planting up with teak, in mixture if possible, were to be selected and marked on the map.

(3) The balance of the area was to be allotted to selection (cum improvement felling) and bamboo working circles.

(4) In the Selection Working Circle artificial patch regeneration was to be tried.

(5) It was desirable that some means of working Karianshola should be devised.

(6) A complete scheme of extraction and exploitation was to be drawn up, entailing tracing and estimating for the construction of all the essential main roads.

224. Mr. M. V. Laurie was appointed as Working Plan Officer, and after a brief study of the methods of topographical strip enumeration surveying, he carried out the enumeration and survey of the whole area between November 1927 and April 1930. The compilation of the enumeration figures and maps, and the writing up of the working plan were completed by March 1931, and the working plan will come into force on 1st April 1931.

225. During the period of the preparation of the working plan, experiments in patch regeneration in gaps caused by selection fellings were carried out by the Working Plan Officer, and these were sufficiently successful to warrant experiments on a larger scale by the District staff. This was embodied in an advance prescription to be carried out over 100 acres in 1930–31.

SECTION 2.—PAST SYSTEMS OF MANAGEMENT AND THEIR RESULTS (PREVIOUS TO 1918.)

226. There is no doubt that at the beginning of the nineteenth century the Anamalai Forests were much richer in teak than they are now. When engaged on the trigonometrical survey (about 1820) Ward and Connor mention that the growth of teak in these forests far surpassed anything they had seen elsewhere. In a few inaccessible sites examples are still seen of the wonderful size which teak attained on these hills ; the best example being a tract near the Palakadavu river.

227. The forests were worked from before 1839 continuously until 1880 to supply teak to the Bombay Naval Dockyard and to the Madras Arsenal.

228. Records showing the quantity of timber extracted under the various leases are incomplete, but the following figures indicate that the quantity was very large :—

In 1861 over 1,677 teak trees were girdled.

229. In 1849 Major Cotton and Captain Michael estimated that the Government and leased forests contained 18,350 teak trees containing not less than 3,670,000 cubic feet in condition to be felled, but in 1866, Captain Beddome reported : " I have no hesitation in saying that the forest requires complete rest for fifteen or twenty years. With the exception of a few knotted and twisted trees there is no teak of any size left, and very few trees that would yield one log. It must be remembered that the few square miles alluded to have been worked incessantly for sixteen years ; also all the Vengai (*Pterocarpus marsupium*) and blackwood (*Dalbergia latifolia*) too has been taken out during the last three years by the Nambidis native contractors." The Collector remarked that the value of timber felled during the years 1855–56 and 1856–57 was Rs. 6,05,171–13–0. This represents at least 2,84,790 cubic feet, as the average sale price had been reported as Rs. 2–2–0 per cubic foot. This is probably the total quantity of timber felled, as the Collector goes on to remark that the actual receipts were only Rs. 2,04,070–6–6. This presumption is supported by the statements of Major Cotton and Captain Michael that the wastage in conversion was from 300 to 400 per cent (sic). This enormous wastage is explained by the fact that the supplies to the Bombay dockyards were in planks 3 inches to 8 inches thick which had to be hewn out with the axe, since sawyers could not be induced to work in these forests.

230. Though extraction probably decreased in 1862–63 when the construction of vessels of war in Bombay was given up, considerable quantities of the planks were sent to Bombay as late as 1857. It is certain that large quantities were extracted from these forests up to the year 1879–80 when felling was stopped in order to give the forest a much needed rest.

231. Though the forests were worked primarily for the supply of timber the question of conservancy and improvement was not altogether overlooked. If little was actually achieved in that direction, the insecurity of the tenure is a sufficient explanation.

232. Major Cotton had already remarked on the necessity for providing for the future in the first year of working by Government. Referring to the marked absence of regeneration he wrote :—

> I did not see in any of these jungles young teak rising where old teak is dying out.

Inspired no doubt by the example of Mr. Conolly, he and his immediate successors did not look beyond planting for the maintenance of future supplies.

233. During 1856 Captain Hamilton obtained sanction for a sum of Rs. 96 for planting, watering and pruning. He appears to have made a small plantation of 2 acres but there is nothing to indicate its location. No further reference to this plantation is found until 1869–70 when Captain Beddome reported that 2 acres of teak plantation had been found, but had been allowed to deteriorate through weeds and fires.

234. In 1871 Captain Beddome recommended "cutting out bamboo clumps and planting with teak."

235. In the same year Mr. Douglas made a plantation at Top Slip of 8 acres known as the 'Mudi' plantation, but the position of this is not now traceable.

236. In 1872–73 a further 8 acres were planted at Waterfall. A portion of this (about 1½ acres) is now a good plantation and a sample plot has been established in it. The remainder of the plantation appears to have failed, and the result is a dense crop of poles of mixed species with one or two teak trees here and there among them.

237. Three and a half acres were planted in 1874 but they cannot now be located. By 1889–90 these 13½ acres of plantation had cost Rs. 262 per acre, and the growth was reported to be "not particularly good." The reason for this high cost was undoubtedly that the necessity for thorough weeding in the first two years was not sufficiently realized. Mr. Popert, in continuation, remarks that "a gradual thinning might be undertaken if a remunerative sale can be found for the poles"—a remark which indicates that sylvicultural operations were then considered to be of less importance than immediate financial results.

238. In 1874–75, from 150 to 200 acres of the forest were cleared of brushwood, creepers and useless saplings, and endeavours were made to keep out fire. This area could not be traced in 1895 when searched for, and the result of the operation is unknown.

239. All the above experiments were done in the British portion of the forests, the Tekkadi leased forests being entirely neglected as far as cultural operations were concerned.

240. The old teak trees themselves bear eloquent witness to the frequency and severity of fires, but we also have the written words of Captain Beddome and others. In 1866 he reported on a fire that lasted four days in spite of all efforts to extinguish it, and reduced to ashes 773 logs and planks valued at Rs. 19,370. In 1880, the same officer (then Colonel and Conservator) wrote of this same tract :—"The fires generally last some eight or ten days, and when they have once swept through the forests there is no further danger."

241. The state of the forests therefore, in 1880 was far from satisfactory. They had been severely depleted by heavy fellings of teak, leaving the less useful and the absolutely useless species to increase. Natural regeneration of teak was conspicuously absent. No fire-protection had been undertaken and only a few spasmodic efforts at regeneration had been attempted, and had proved an expensive failure.

242. The forests were then given a complete rest for five years, and in 1885 Mr. Porter carried out a series of enumerations covering 2½ per cent of the area, and prepared a felling scheme (called Mr. Porter's "Working plan") for the Tekkadi leased forests. This was the first attempt at regulating the fellings. Mr. Porter stated that "the present scheme has been drawn up with a view to ascertain the probable outturn of the forest, and its value, so as to

obtain a rough basis for changing the terms of the lease." He pointed out the uselessness of an elaborate working plan until there was security of tenure, and certainty of continuity. "If the powers of renewing the lease cannot be obtained for Government it would hardly be wise to draw up an elaborate scheme for improving the forests, as in eighty years' time it will be handed back to the lessor in a better condition than it is at present. For this reason the present scheme does not contain the elaborate details of a working plan."

243. The whole area of the Leased Forest was divided into 39 compartments, the object of this division being merely to take stock. The compartment lines were straight, and the valuation surveys were carried out along them, covering 2½ per cent of the area. Of the 39 compartments three (Nos. 37, 38, 39) with an area of 3,626 acres consisted entirely of ever green forest and grass lands which were shown as unworkable. The remaining 36 compartments of deciduous forest aggregated 13,514 acres having an average area of 375 acres.

244. Mr. Porter adopted what he called the selection system for working the forest. (This was not the selection system as it is now known, but merely consisted of felling the best timber as it became mature without any provision for regeneration or improvement of the forest.) He fixed the rotation at 120 years, which is the age that ring counting showed to be necessary for the production of the most useful size of teak, viz., 2 feet to 2½ feet in diameter. (This must mean basal diameter at stump height.)

245. The rotation was divided into four periods of thirty years each during which the whole forest was to be worked over. The yield was fixed by the number of trees to be felled, based on the valuation surveys. The 36 compartments were divided into five blocks in such a manner as to equalize the total number of first-class trees in each. Each block was to be worked over in six years.

The following statement shows the number of first-class trees (2 feet in diameter and above) to be removed yearly :—

Species.	Number of first-class trees to be felled in the first period 1886 to 1915.	Average per annum.	Average volume per tree in cubic feet.	Average volume yielded per annum in cubic feet.
Teak	15,548	518	90	46,620
Rosewood	1,163	38	90	3,420
Vengai	504	16	90	1,440
Superior, miscellaneous ..	37,367	1,245	40	49,800
Inferior, miscellaneous ..	3,629	120	40	4,800
Total ..	58,211	1,937	..	106,080

246. Mr. Porter also calculated the number of first-class trees that would be available in the second, third and fourth periods by presuming that four-fifths of the existing second-class trees, three-fifths of the third class, and two fifths of the fourth class would become first-class trees during the successive periods. The figures showed that for teak and rosewood the number in the lower classes was actually on a diminishing scale. Of class I (marketable trees), teak formed nearly 27 per cent of the total. In class II the percentage decreases to 24 per cent. In class III a further decrease to 14 per cent is noticed, and in class IV which has probably grown since our working the forest, teak forms only 7 per cent of the crop. It may be expected therefore that the yield of teak and Dalbergia latifolia under the present working plan and for the next eighty or ninety years will be greatly reduced.

247. Fellings under Mr. Porter's scheme started immediately in 1886, and continued until 1915. The sequence of the compartments and the quantities extracted did not follow the prescriptions of the plan. It was found that the enumeration on which the plan was based was far from accurate, and that fellings

fell short of the quantities estimated. By 1893, after the plan had been in operation for seven years, the following quantities had been extracted :—

Species.	Number of trees prescribed by plan.	Number of trees actually felled.
Teak	3,626	1,741
Rosewood	266	14
Vengai	112	5
Other woods	9,555	2,445

The sequence of the coupes was departed from at the very outset, and fellings soon became subservient to extraction schemes represented by the tram-line, the slip, and later the ropeway, and the saw mill.

248. No cultural operations were prescribed in the plan, but proposals for fire-protection of the area, and for restriction of grazing were made, though it is not known to what extent they were carried out.

249. The year after the plan was brought into force, a revised lease was entered into, which gave Government the right to renew the lease at will indefinitely. This clause altered the whole situation making Government the virtual proprietors of the forest for ever, and under these conditions it became worth while to attempt some measures of conservation and improvement of the leased forest.

250. It was very soon recognized that Mr. Porter's proposed system of " Jardinage " was not suitable, and that natural regeneration and improvement of the forest could not be secured thereby. Mr. Porter himself was the first to arrive at this conclusion, and wrote in the administration report of 1888–89 : " One important fact, however, is proved, viz., that plenty of light and air are required to secure seedling regrowth of teak, rosewood and vengai ; that teak, rosewood and vengai seedlings will spring up when plenty of light is let in is no mere supposition ; the Sholakarai block (Bolampatti range) is an example ; that the same result is obtained on the Anamalais is proved by regrowth in open spots, round camps and in fire-lines." There is little doubt, therefore, that in these forests Jardinage should be discarded for the " *mode des eclaircies.*"

251. From time to time Conservators inspected the forests and wrote notes in all of which the absence of proper regeneration was remarked on. Various attempts to obtain natural regeneration by opening out the canopy were made from time to time, but the result in every case was a dense mass of weeds and creepers in which any regeneration that may have been present perished.

252. In 1894 Mr. E. P. Popert, Conservator of Forests, Central Circle, was specially deputed to inspect and advise on these forests in view of his experience of teak forests in Burma. His report is published in B.P. Forest No. 174, dated 4th April 1895, and the following extracts are particularly interesting :—

> Although fire-protection must have acted beneficially on the existing stock and improved the soil, it has not had a similar effect upon teak reproduction. This must be the case wherever the canopy has been broken in a moist, mixed forest with teak. Exemption from fire with plenty of light has produced a thick crop of coarse grass, and has favoured the less valuable, quick-growing plants, such as bamboo, *Grewia*, etc. I do not take the pessimistic view regarding existing natural reproduction expressed in some of the inspection memoranda, and believe that it will be found that over the great part of the teak-producing area there exists sufficient young growth of teak to form the chief '*peuplement*' of these parts. Doubtless for the first few years the seedlings die down annually, but throw out a more vigorous stem each following year, and with a little artificial aid in the way of clearing will overtop the grass, etc. The system of jardinage under which the forests have been worked should be given up, and for it improvement fellings with cultural operations substituted. Teak trees over two feet in diameter should be felled only when there is already a sufficiency of young teak, or where attacked by ficus ; all trees of the less valuable kinds dominating teak, blackwood or vengai should be felled or girdled. Simultaneously, i.e., in the same year as the felling operations, dibbling of teak, blackwood and vengai seed in blank areas should be undertaken. Patches or strips should be cleared of grass and undergrowth, the soil loosened and the seed dibbled or sown broadcast. These patches should be of considerable size, and will require weeding or clearing one or two years after sowing. It will

> probably be found that even without sowing, if patches are cleared in the vicinity of mature teak, natural seedlings will spring up. Existing young growth of the valuable kinds should be cleared and all creepers should be cut. Compared with Burma teak forests the absence of large climbers is remarkable. Lantana is spreading rapidly. I regret I can offer no practical suggestions for the eradication of this weed.

Mr. Popert also advocated planting by " Taungya systems."

253. Between 1898 and 1911 some further attempts were made to obtain natural regeneration by felling bamboos, and cutting out inferior species, but in no case was satisfactory stocking achieved, and the results were not commensurate with the expenditure. In 1908 to 1910, Mr. P. M. Lushington cut out bamboos in the coupe which had been felled on the selection system in 1907–08, burnt the area and dibbled teak with fair initial success, but owing to lack of tending in subsequent years, the results of the experiment were lost.

254. At about the same time, between 1908 and 1911, Mr. Lushington clear-felled an area on the south side of the tram-line near Top Slip, and dibbled teak from germinating seed in dumps. Mr. Venkatarama Ayyar, who was then Range Officer, did most of the work himself. Guinea-grass was put in subsequently with the idea of suppressing the weeds and of supplying fodder for the Government bullocks. The teak was very healthy to start with, but later lack of attention spoiled a very promising experiment. Wild animals, attracted by the guinea-grass came in and trampled down the teak, and the few surviving plants suffered from being choked by the weeds and guinea-grass on account of insufficient tending.

255. In 1909 Mr. Arbuthnot prepared a working plan for the British portion of the forest east of Mount Stuart, which was sanctioned in 1911. No fellings were prescribed under this plan. The area was divided into three parts. In one girdling of inferior species interfering with the growth of superior species was prescribed. In the second portion it was prescribed that 30 acres should be cleared and planted each year, while the third portion, including Karian Shola, was to be given a rest. In the years 1911 and 1913, inferior trees were girdled on 179·4 and 138 acres respectively. This operation let in a good deal of light which greatly helped a number of young teak, *Dalbergia latifolia* and seedlings of other species, to make headway. It also helped weeds and lantana to do the same ; so in order to assist the regeneration, a clearing and weeding which included the cutting of bamboos and useless species, was sanctioned in 1916 over an area of 100 acres. The operation was carried out over 22 acres at a cost of Rs. 165–5–0, much to the advantage of the existing young regeneration. The full acreage could not be worked owing to the demands on the labour available by the Working Plan Party and the Forest Engineer.

256. In the years 1912 to 1915, $111\frac{3}{4}$ acres were clear-felled and planted with teak and *Dalbergia latifolia* on the south side of the tram-line near Top Slip. In order to keep down weeds, the area was densely stocked with guinea-grass, which apart from being a weed in itself, attracted wild animals which destroyed the plantation. The area is now a mass of bamboos with scarcely any teak in it at all except for one small patch of flourishing teak on the old nursery site which was not planted with guinea-grass. The plantations did so badly that it was decided to give up planting on the plea that it was unsuitable, and it was probably for this reason that Mr. C. C. Wilson, in his reconnaissance report, proposed to rely on natural regeneration for stocking his clear-felled areas.

257. Mr. Wood, who prepared the new Mount-Stuart Working Plan which replaced Mr. Porter's and Mr. Arbuthnot's plans in 1918, was not of this opinion, and he carried out experiments both near Mount Stuart bungalow and in the Ulandi valley to show that teak plantations could be raised from seed successfully and at a reasonable cost, and since his experiments were the basis of the regular annual clear-felling and planting which has been done every year since 1919, they will be described in detail.

258. The experiment was started in 1914 by Mr. Fischer, in an area of 10·9 acres just below Mount Stuart. The area was well stocked with bamboos, which were to be felled and burnt in the hot weather of 1915 over $6\frac{1}{2}$ acres. Over the

remaining 4·4 acres the bamboos were felled, cut up and removed off the area. The cost of felling the bamboos was Rs. 12–0–8 per acre, and of cutting and removing them from the 4·4 acres was Rs. 4–8–8 per acre. It was estimated that the complete clearing of the area could be done for Rs. 20 to 25. Fortunately the burning of the 6½ acres was not carried out as it resulted in a further experiment being made later. The monsoon then came down on the area containing the felled and unburnt bamboos, which speedily became a mass of weeds, creepers, lantana and bamboo regrowth, so that the experiment was spoilt as regards the relative cost of the two operations. Mr. Fischer took over the post of Principal of the Forest College in 1915, and it fell to Mr. Wood to deal with these plots. As the experiment was so important, Mr. Wood's own report is quoted verbatim—

> It costs a great deal more than Re. 1 per acre to get rid of the tangled mass after the monsoon, but the cost was no test of the original experiment. When all the area had been burnt except the trees standing on the area nothing was left except a very few seedlings that had found themselves situated on the outskirts of the area. The area was therefore dibbled with teak 6 feet by 6 feet. These seeds were dibbled in three at one spot, and a bamboo stick, a yard high, was placed to mark the place of the seeds, so that their germination could easily be spotted, and the weeding made efficient. The treatment on these plots is given in detail as it will have considerable bearing on the regeneration of these forests. On the plot on which the bamboos were merely cut and removed there were a considerable number of trees more per acre than on the plot where the bamboos were burnt. The Lantana immediately took possession of the plot and although there are seedlings of teak, *Dalbergia latifolia* and *Terminalia tomentosa*, they are not in satisfactory numbers. The Lantana has been removed in January 1917 and the area was found to be so blank that where there was sufficient light, teak seeds have been dibbled in, 3 feet by 3 feet, to protect the slopes, and to replace the weeds and Lantana. These seeds germinated excellently in June 1917 in spite of the abnormally short rainfall, and have given a complete crop with a very small percentage of casualties.
>
> On the plot on which the bamboos were eventually burnt there were fewer trees than on the other plots, so that considerable areas had abundant light for teak and other desirable species. The dibbled seed and natural seed came up excellently in such open portions of the plots. Where the trees had been left the effects of drip and shade were very evident. The seeds were dibbled before the end of March, and the ground was then perfectly clean. By the middle of October 1916 the leading seedling from the dibbled seed was 6 feet high, and by the middle of January 1917 it was 8 feet high. Particular attention was paid to weeding, and Rs. 12 were spent per acre on it. Besides the seedlings from dibbled seeds, and seeds which were in the ground before the burning, a number of fine shoots from old stocks came up which attained to a maximum height of 12 feet in January 1917. The height of the seedlings in January 1917 varied from a few inches to 8 feet. Many rosewood, *Terminalia tomentosa*, and *Pterocarpus marsupium* seedlings also made their appearance.
>
> At the same time that the seeds on these plots were being dibbled an experiment was made at Ulandi on the other side of the Vengoli-Umayamalai ridge. The rainfall to the south of the ridge is heavier than on the Mount Stuart side, and in consequence the weeds are much denser and larger, and natural teak seedlings scarce. A working plan for this portion of the forest had been made some years previously, but owing to delay in road construction the working was in abeyance at the end of 1915. The working plan prescribed certain operations to procure reproduction of teak and rosewood, and laid down that, if necessary, artificial reproduction should be resorted to. As none of these operations had been carried out an attempt was made early in 1916 to make up for lost time. The attempt took the form of an experiment in concentrated regeneration of teak. The compartment I, in which it was made, was rocky in parts with patches of deep soil. Plots on such deep soil were selected 2 by 2 chains square, so as not to fell teak and rosewood for which timber there was no export road ; the plots were chosen in amongst the teak and rosewood, but with none of the trees of those species actually on them. The plots contained a great deal of young bamboo growth. Now in these forests the full grown *Bambusa arundinacea* gives little trouble when the clump is fully felled. But the writer had had so much trouble with the regrowth of *Dendrocalamus strictus* in the Kurnool forests in building up teak plantations there, that great care was taken to grub out all this young *Bambusa arundinacea* by the roots. The plot was clear-felled and all the felled material removed off the plot. The main idea was to prove that in these forests with the rainfall so favourably distributed teak reproduction could be satisfactorily obtained by dibbling, if sufficient trouble was taken with weeding. As already mentioned above, Mr. Popert, so far back as 1894, had recommended dibbling and weeding, and up to 1916 it had not been put on a proved basis. Accordingly

every effort was made in this experiment to prove that the system could be made successful. The results proved eminently successful. Teak seeds, three at a time, were dibbled in 3 feet by 3 feet over five plots before the end of March 1916. The early rains of May brought up the seedlings, and with careful weeding the plants progressed so well that Mr. P. M. Lushington, Conservator of Forests, Southern Circle, who had been specially requested to visit the forest with reference to the new working plan, gave it as his opinion that the seedling growth was as far advanced on 3rd July 1916, the date of his inspection, as the Nilambur plantation planted out plants usually are a month later. The cost of the plots was high on account of the grubbing out of the young bamboos. It amounted to Rs. 63 per acre exclusive of weeding. But the first object aimed at was the proving that dibbled seeds would prove successful. The total cost of weeding per acre was Rs. 12–8–0 in the first year. The plants were beyond the danger from weeds at the end of the first year. Nothing was actually spent on weeding during the second year, but the local forest guards kept the plots clean.

Besides the fact that success could be obtained by clearing, dibbling, and proper weeding, the experiment showed that plots 2 by 2 chains gave an undue proportion of the area which received the drip of the adjacent trees. Plots of larger acreage will prove more satisfactory, and all growth regardless of species should be cut on them.

259. It was on the results of these experiments that Mr. Wood prescribed clear-felling and concentrated regeneration by sowing teak seed as a regular measure in his working plan.

SECTION 3.—PAST SYSTEMS OF MANAGEMENT AND THEIR RESULTS, 1918 TO 1930.

260. *General.*—Under Mr. Wood's working plan the Mount Stuart forests were, for the first time in their history, being worked conservatively. The annual quantity of timber extracted was greater than that taken out under Mr. Porter's working plan, but at the same time the potential stocking of the forests was being greatly increased by means of clear-felling and concentrated artificial regeneration of valuable species. The method of working was as follows.

261. The whole workable forest was divided up into 50 annual selection felling coupes laid out so as to give approximately equal annual yields of timber of 7 feet girth and over. These were worked over by selection fellings, and an area in the best locality in each coupe was chosen for clear-felling up to the maximum size that could be regenerated and tended with the labour available. The working plan anticipated that only 25 acres per annum could be attempted, but the area was gradually increased up to a maximum of 250 acres in 1925 and 1926. This area was found to be too unwieldly for efficient regeneration, and it was reduced in subsequent years.

262. The disadvantages of this method of working are as follows :—

(*a*) When large regeneration areas of over 150 acres were taken up, it was found in some cases that more than the total calculated annual yield was obtained from clear-fellings alone, and that there was no need to do any selection fellings. The forest was thus not being worked to its best capacity, as parts were being left unfelled which had not been worked for over forty years.

(*b*) In selecting regeneration areas of 100 acres or more within a coupe of about 500 acres, it frequently happened that unsuitable areas were included, and the attempts to make plantations on such unsuitable areas were complete failures.

(*c*) The total area undoubtedly suitable for planting with teak has since been ascertained to be about 8,500 acres. On a rotation for the plantation of 100 years the annual area for clear-felling is therefore only about 85 acres. By regenerating as much as 150 acres or more annually, all the suitable areas would have been planted up in about sixty years, leaving forty years of the rotation without any clear-fellings. The yield from selection fellings during those forty years would not be sufficient to maintain the log market at Pollachi, and the final yield from the plantations would also have been uneven. As it is, during the last eleven years, 1,869 acres have been regenerated, of which about 160 may be discounted as having failed. The balance of 1,709 acres corresponds to twenty years' work at the rate of 85 acres per annum. It has actually been done in eleven years, so that at the time of final felling there will be some inequality in the areas and ages of the plantations first felled. The difference of eleven years one way or the other is however not a serious matter, and under the present working plan the areas for clear-felling are regulated so that the whole area suitable for clear-felling will be regenerated in the next eighty years, assuming that the plantations already formed are equivalent to twenty years' work.

263. The disadvantages mentioned above were not anticipated in Mr. Wood's working plan, as in their most optimistic dreams it was not expected that they could do more than about 50 acres of clear-felling per annum, and 25 acres was estimated as the probable maximum area that could be attempted. Moreover it was not known how much of the total area was suitable for clear-felling and planting.

264. In 1926, pending the revision of Mr. Wood's working plan, all the areas considered suitable for clear-felling and planting in the portion of the forest east of the Malabar boundary were selected and marked by Mr. Krishnaswami, and all plantations made between that date and 1930 were confined to these selected areas.

265. *The fellings.*—The yield calculated by Mr. Wood for the first felling cycle of fifty years was "not less than 100,000 of cubic feet per annum of timber of 7 feet girth and over." It is not stated in the working plan whether this meant 7 feet girth at breast height (4 feet 6 inches from ground level), or basal girth at stump height. Since his enumeration was done at breast height, it is probable that 7 feet breast height girth over bark was intended. His increment calculations were however, based on a diameter curve for teak compiled from ring countings on stumps, and there is no evidence that any correction was applied to convert stump height diameters under bark to breast height diameters over bark. The annual coupes were laid out so as to give a yield of 89,000 cubic feet as nearly as possible each year. It is not stated why this figure was adopted when the yield had been calculated as not less than one lakh of cubic feet per annum.

266. Most of Mr. Wood's felling prescriptions were departed from as soon as his plan came into operation. The order of the coupes was based on the assumption that Mr. Bright's steam tramway was going to be constructed. Since we were spared such a catastrophe, the coupes had all to be altered to suit existing transport facilities.

267. The quantity of timber felled did not correspond either with the estimated outturn of the coupes, or the calculated yield.

The following quantities were extracted annually :—

Year.	Selection Fellings.	Fellings of timber under 7 feet in regeneration areas.	Miscellaneous fellings.	Total.
	C.FT.	C.FT.	C.FT.	C.FT.
1919–20	38,157	13,290	3,771	55,218
1920–21	..	3,455	12,400	15,855
1921–22	64,392	42,587	336	107,315
1922–23	77,449	62,098	12,582	152,129
1923–24	72,077	41,293	2,645	116,015
1924–25	80,342	59,204	273	139,819
1925–26	64,896	31,908	8,012	104,816
1926–27	37,226	29,453	..	66,679
1927–28	70,768	25,565	..	96,333
1928–29	77,999	48,411	5,874	132,284
1929–30	51,318	51,150	26,006	128,474

268. In the above table, the selection fellings include the trees of over 7 feet girth filled in the regeneration areas, and the regeneration area fellings consist only of saleable timber of 7 feet girth and under. It will be seen that the yield from selection fellings is less than the outturn estimated by Mr. Wood.

269. *The regeneration areas.*—The following table shows at a glance the areas regenerated up to 1930, and their cost :—

Year.	Area in acres.	Cost up to date.			Cost per acre.		
		RS.	A.	P.	RS.	A.	P.
1916	5	195	0	0	39	1	0
1919	28	1,307	2	0	45	13	0
1920*	8	843	8	0	105	1	0
1921	29	1,718	7	0	59	3	0
1922	126	6,448	13	6	51	2	0
1923	193	10,414	14	4	53	11	0
1924	226	10,584	12	1	46	13	0
1925	250	16,638	8	6	66	9	0
1926	251	16,121	14	6	64	3	0
1927	155	99,905	12	0	63	15	0
1928	144	7,985	11	6	55	7	0
1929†	151	8,809	0	6	58	5	0
1930	224	In progress.			....		

* Failure. † Still may require some tending.

270. The following statement shows the cost per acre of the various regeneration operations for the last three years :—

Particulars.	Cost per acre.								
	1927.			1928.			1929.		
	RS.	A.	P.	RS.	A.	P.	RS.	A.	P.
Felling useless species and bamboos ..	20	15	0	14	14	2	15	14	0
Burn and reburn	9	3	0	7	2	10	9	0	0
Staking and dibbling	3	7	0	2	4	7	2	2	0
Inspection paths	0	3	0	0	8	0	0	4	0
Seed collection and nursery work ..	1	6	0	3	8	0	2	10	0
Weeding and replacements, first year ..	22	0	3	15	13	6	20	1	5
Do. second year.	6	14	3	11	4	6	8	6	5
							Incomplete.		
Total ..	64	0	6	55	7	7	58	5	10

The above figures do not include tending and cleanings done in the third and subsequent years.

271. *Species planted.*—The species planted in the various plantations have been described in detail in Chapter II, section I. It is sufficient to note here that previous to 1926, pure teak was planted, except in certain swampy areas where *Terminalia tomentosa* was introduced. In the years 1926, 1927, and 1928, alternate strips of *Dalbergia latifolia* were sown as an experiment. In 1929 pure teak was again reverted to, except in a small area where teak and *Dalbergia latifolia* were sown at the same stake. The whole of 1930 regeneration area was treated in this manner, since it appears that this will be a cheap and successful method of introducing a mixture, the proportions of which can be controlled at will when the thinnings are being made.

272. *Method of regeneration.*—Hitherto all the regeneration has been done by sowing seeds at stake, at an espacement of 4½ feet by 4½ feet. The procedure is as follows.

273. Burning and clearing the area are finished by the end of February or early in March. The area is then staked with bamboo pegs 2 feet long, at an espacement of 4½ feet by 4½ feet. Teak seed is dibbled in loosened patches at each stake at the end of March, and seeds of *Dalbergia latifolia* and other species in early June, just before the outbreak of the monsoon. Usually about six seeds are sown at each stake. Weeding commences in May before the teak has germinated, and proceeds almost continuously until the end of September or even early October. The ground is usually gone over about six or seven times during the first rainy season. In the course of weeding casualties are replaced by transplanting seedlings from stakes where more than one seedling has come up to stakes where nothing has germinated or survived. Further replacements in a bad year may have to be done from germinating seeds taken from dumps of seed made for that purpose, or else from nursery transplants.

274. The advantages of this method of regeneration over transplanting nursery seedlings are—

(1) The method is initially cheap and high nursery expenses are avoided.

(2) The method is independent of weather conditions at the time of sowing, and certainty of getting the sowing finished by a given date is assured.

275. The disadvantages of sowing as compared with planting are : (1) That at Mount Stuart, the seed germinates very late, and usually has not finished doing so until late in August. (2) Seedlings that germinate before the monsoon is established, or just before a dry spell of weather after the beginning of the monsoon frequently die from lack of sufficient moisture. (3) In an average season, only about 30 per cent of the final stocking in October of the first year has come from the original sowings. About 70 per cent are replacements. In a very favourable year, as much as 80 per cent of the original seedlings may survive, but in a bad year, as much as 90 per cent of the crop may have to be replaced. (4) Although the actual operation of sowing seeds at stake is simpler than planting seedlings, it is impossible to supervise it so well, as it cannot be easily seen whether the seeds have been covered to the correct depth. Furthermore, lazy coolies who are at some distance from the seed supply will, when no one is looking, put only two or three seeds at a stake, instead of six or eight so as to make their supply last longer and save a journey to the seed bags.

276. It appears that 'stumps' (root and shoot cuttings) avoid most of the disadvantages of sowing, and of planting out nursery seedlings, and under this working plan a certain percentage of stump planting will be prescribed. Stumps are slightly more expensive initially, but they are not very susceptible to bad weather conditions, they sprout early in the monsoon and get well ahead of the weeds, the percentage of failures is very low, and they are easy to plant. It is expected that the saving in the cost of replacements and weeding and the greater certainty of the method will amply repay the extra cost of raising the stumps.

277. The weedings have hitherto consisted merely of cutting back the weed growth to ground level, either all over the area or else in strips or patches around each plant as the necessity arose. The advantages of clean scraping so as to kill the weed roots, and of soil aeration have been under investigation during the last few years, but it has not yet been definitely decided whether such operations repay their extra cost by saving in weedings later on. There is no doubt that the plants benefit by such treatment, but in a rotation of 100 years, the extra growth in the first year is not going to make any appreciable difference, or give any advantage unless it can be proved that by employing such more expensive methods, the total cost of formation can be reduced.

278. *Thinnings.*—Each plantation has been inspected after five years to see if it required thinning. It is found that in the best quality areas a thinning should be made in the fifth or sixth year, but in the poorer quality areas the stocking is so poor that in places thinnings cannot be done at all for many years. First thinnings have been carried out in all the plantations made previous to 1925, in the areas that required thinning. Second thinnings have been done in

1916 and 1919 plantations. It was found, when thinning, that it was advisable to do a cleaning and creeper cutting throughout each plantation shortly before thinning, because if the creepers were not cut, the crowns of the trees were tied to each other, and when felling a marked tree, the crown of an unmarked tree was frequently broken off. The thinning officer was also able at the same time to inspect the clearing work thoroughly.

279. The following statement shows the areas thinned, the cost of thinning, and the number of poles extracted from each plantation :—

Year of thinning.	Plantation thinned.	Area thinned.	Cost of thinning.	Number of poles extracted.
		ACS.	RS. A. P.	
1919–20 ..	Waterfall plantation	11½	10 1 0	120
1922–23	1916 Mount Stuart plantation ..	5	8 5 0	323
1923–24	(1) 1917 Regeneration area Mount Stuart.	Not known.	By subordinates.	130
	(2) Topslip Regeneration area ..	,,	9 6 0	175
1924–25	1919 Regeneration area	29	95 8 0	Not known.
1926–27	1921 Regeneration area	29	20 9 0	Do.
1928–29	1922 Regeneration area	45	96 11 0	5,478
	1922 Regeneration area	80	180 11 0	
	1923 Regeneration area	160	161 14 0	
	1916 Regeneration area	5	9 6 0	
1929–30	1919 Regeneration area	29	48 8 0	1,095
	1924 Regeneration area	226	201 4 0	1,900

280. *Selection working.*—As previously stated, the selection fellings were made down to a 7-foot girth limit. No cultural measures whatever were undertaken. The best trees were removed, and the useless species left to regenerate themselves in their places. It has been shown that the natural regeneration of the valuable species is so little as to be insufficient to replace the timber extracted, and it is, both from a sylvicultural point of view and from the point of view of forest management, a most irregular proceeding to cut down any timber without ensuring that it will be replaced. The effect of the so-called selection fellings has been to cause the gradual but certain degeneration of the forest.

281. *Bamboo exploitation.*—Since the new ghaut road was opened for traffic in 1924 the quantities of bamboos extracted annually have greatly increased. The method of felling them at a height of about 15 feet above the ground is both wasteful and unsightly, but bamboos are so plentiful that any restrictions in cutting are unnecessary, and would only reduce the prices which the coupes fetch in auction.

282. *Karian Shola.*—No fellings have been carried out in Karian Shola. The only regular work which has been done there is the tending of existing *Hopea* regeneration by letting in a certain amount of light by regulated removal of the trees of useless species in the lower and middle storeys. The young *Hopea* responds to this tending by increased rate of growth. So also does the *Strobilanthes* which threatens to swamp the *Hopea* regeneration if it is less than about 2 feet in height at the time of carrying out the operation.

283. *Fire-protection.*—As previously stated, Mr. Wood's system of fire protection was carried out in a modified form for three years and then abandoned on account of shortage of labour. Subsequently only the regeneration areas and timber depots were protected. For details of the areas burnt each year, and the sums spent on fire-protection please see Chapter II, paragraph 61.

284. *Lantana eradication.*—The scheme of Lantana eradication by uprooting prescribed by Mr. Wood in the working plan was carried out near Anapadi for two years (1919–20) at a cost of Rs. 194–9–0. Again in 1920–21, 40 acres were cleared at a cost of Rs. 482 or Rs. 12 per acre. These areas are now just as full of Lantana as ever. Eradication by uprooting was discontinued after 1921 as it was found to be expensive and ineffective.

285. Under Mr. Tireman's orders, burning of Lantana was tried as a method of eradicating it. It was attempted in 1925, but failed on account of early rains. In 1926, 6,000 acres between the tram line and the Vengoli ridge were burnt, and in the next year 2,500 acres in the same area between the tram line and the Tunacadavu river were similarly treated. It was found that this treatment discouraged the weed temporarily, but that it came up again just as thickly a few years afterwards. This is seen very clearly in all the areas which have been swept by forest fires, which are, within a year or two, densely infested with Lantana. The only permanent result of the operation was to destroy most of the existing regeneration of timber species.

286. *Experiments.*—In 1926, the Forest Research Officer attempted to raise *Dalbergia latifolia*, *Pterocarpus marsupium* and *Albizzia lebbek* in plots in deciduous forest, on the side of the Anaipadi road near Top Slip, by transplanting nursery seedlings, by notching nursery seedlings, and by sowing seed at stake. The experiment showed that in every case sowing at stake gave the least number of survivals and that usually transplanting in pits was preferable to notching. The plots were all overgrown with elephant grass in 1927, and abandoned.

287. *Artocarpus hirsuta as an underwood in the teak plantations.*—In 1925, three acres were under planted with *Artocarpus hirsuta* in each of the 1922, 1923, and 1924 regeneration areas at an espacement of 18 feet. Most of this was done with seedlings brought from Travancore, though a small portion was done by direct sowing at stake. In 1926, 5 acres in each of the following plantations, 1919, 1921, 1922, 1923 and 1924, were similarly dealt with. Most of the plants died out in the first year, and in 1927 only one or two stray plants could be found. The experiment was not continued since it was apparent that *Atrocarpus hirsuta* could not be introduced in teak plantations by sowing or transplanting seedlings. It appears that seedlings of this species require shade in the hot weather which a deciduous crop like teak cannot give.

288. In 1927, *Artocarpus hirsuta* was sown with *Acrocarpus fraxinifolius* in a corner of the regeneration area of that year. The *Acrocarpus* was very successful at the start, but the *Artocarpus* was almost a complete failure. Later on, the *Acrocarpus* which had grown very fast, was attacked by a stem borer, and also suffered badly from having its bark stripped by bison or sambhur. It is still growing fairly well in spite of the damage it has suffered.

289. In the same year *Hopea parviflora* was planted in the open along with teak, but in the ensuing hot weather it all died off.

290. *Adina cordifolia.*—In 1924, it was noticed that a copious crop of *Adina cordifolia* seedlings mixed with *Stephegyne parvifolia* had come up naturally in the south-west corner of 1922 plantation, and it appeared that if similar crops could be produced in future, they might serve the very useful function of helping to form a mixed crop in the plantations. Accordingly an experiment to try and repeat this regeneration was ordered. Further plots, having between them nine *Adina cordifolia* mother trees, were selected below the Mount Stuart rest-house, and the following works were carried out. All bamboos, small trees and undergrowth were cut to a radius of 60 yards from the mother trees, leaving the latter along with three or four other large trees which were girdled. The clearing was done in February 1926, and burning of the cut material was completed in March of the same year. The area thus cleared and burnt was about 4 acres altogether, and the work cost Rs. 72–12–0. After the burn, all the unburnt material was thrown outside the area, and the ground was kept clear. The *Adina* mother trees were in fruit in March and April 1926, and by May all the seeds had fallen.

291. In June 1926, at the commencement of the monsoon, a thorough weeding of all the plots was done at a cost of Rs. 23–10–0. Thus the total cost of preparing the ground was Rs. 96–6–0 or Rs. 24–1–6 per acre. Until about the end of July 1926 it was thought that no germination had taken place but this was on account of the difficulty of identifying the seedlings. Towards the end of August germination in dense patches was noticed. This was particularly good in the plot just below Mount Stuart, where about 50 per cent of the area was

covered with dense pure *Adina* regeneration. In the other plots only small patches of regeneration scattered here and there were found, but wherever it occurred the density was very great. In addition to the *Adina* seedlings a fair quantity of teak, *Pterocarpus marsupium*, *Terminalia tomentosa* and *Dalbergia latifolia* seedlings came in naturally, teak and *Pterocarpus marsupium* being predominant. In April 1927 the *Adina* seedlings averaged 9 inches in height, and in October, only six months later, the average height was about 5 feet 9 inches. In August 1928 the average height was 8 feet, and the tallest seedling was 9 feet 2 inches tall. This area will eventually form a well-stocked mixture of *Adina*, teak, *Pterocarpus marsupium*, and *Terminalia tomentosa*, with one or two *Dalbergia latifolia* trees. No thinning of the *Adina* has been carried out so far.

292. *Gap regeneration in selection forest.*—In 1928 some experiments in the artificial regeneration of gaps in selection felled forest were made by the working plans officer. The purpose of the experiment was to try and find some means of artificial regeneration suitable to the simple selection system as carried out in mixed deciduous forest, since it had been proved that the natural regeneration of valuable species was insufficient to prevent the rapid deterioration of the crop under this system of working.

293. Some thirty gaps, or ' funnels ' as they were termed, were chosen in the current year's selection-felled coupe during December 1927. The largest available gaps in the canopy were selected, but it was difficult to find enough gaps of sufficient size. No artificial enlarging of the gaps was done, and the average size of a gap was about 50 feet in diameter. It was found that the largest gaps occurred where the crowns of the felled trees had fallen, and that the gaps where the trees had originally stood were comparatively small. This was especially noticeable in bamboo forest.

294. During January and February the branch-wood from the felled trees was billeted and stacked in the middle of each gap. The piles were usually about 5 feet high and 12 to 20 feet in diameter. There was never any difficulty in finding sufficient material for a really hot burn. The ground was scraped clean all round each pile to prevent fire escaping into the surrounding forest, and the stacks were burnt about the middle of March. The heat given out by the burning stacks was terrific, and the soil was in many cases burnt to a red clinker. In spite of all precautions, fire escaped from one gap and burnt about 100 acres of forest including the stacks in about a dozen other gaps. Scarcely any damage was done by the fire, and several natural gaps where fallen trees had been burnt, were regenerated with good results. In practice it will not be possible to prevent fires from escaping from each individual gap, unless great expenditure is incurred. A gap cannot be considered ' safe ' until about 24 hours after the burn since a very light wind will blow small pieces of glowing charcoal off the patch into the dry leaves on the ground round about, and so start a fire.

295. Teak, *Pterocarpus marsupium*, and *Terminalia tomentosa* seeds were sown in loosened patches in the gaps at the end of March. The patches were 3 feet to 4 feet apart, and about six seeds were sown in each. Teak was always sown in the centre of the burnt portion, and in a few gaps was continued out to the edge. In most gaps however, *Terminalia tomentosa* and *Pterocarpus marsupium* were sown round half of the periphery. Later on, just before the rains, *Dalbergia latifolia* was sown round the remaining part of the edge of each gap, and *Lagerstrœmia lanceolata* was broadcasted throughout.

296. One weeding was carried out in August, and a second in October of the first year. These weedings were not sufficient, and it would have been better to have done three weedings in the first year.

297. Germination was, on the whole good. Teak germinated well except in places where the burn had been too hot, and the soil had been baked to a red colour. In such places it failed completely. The *Terminalia* and *Pterocarpus* germinated in some early showers in April, and many died before the monsoon had started. These two species should therefore not be sown before June. At the end of October there was a good stock of small healthy seedlings of the

species sown on the ground. A considerable amount of dense *Stephegyne parvifolia* regeneration accompanied by a few *Adina cordifolia* and *Bridilia retusa* seedlings appeared naturally in some gaps. The *Dalbergia latifolia* and *Pterocarpus* seedlings had in several instances disappeared, and browsing of all species except teak was noticed. The growth of the teak in the gaps was, if anything, slightly better than in the plantations of the same year, and the weed growth was distinctly less. It was an unusually dry season, and in a normal year more weeding would be necessary. The effects of drip were apparent, but the seedlings did not seem any the worse for it.

298. In June 1929, the stocking of the gaps was about the same as in the previous October, and it was thought that the plants were large enough to look after themselves. In August, however, they were found to be smothered in a mass of weeds and creepers, and had apparently scarcely grown at all. One weeding was done in September 1929.

299. The cost of the various operations was not kept separately for each gap, but the following shows the amounts of work each coolie could do, and the approximate cost, using coolies at eight annas :—

Description of work.	Number of coolies employed and the amount of work turned out.	Coolies at 8 annas. Cost per gap.		
		RS.	A.	P.
Billeting and piling	Six coolies could do from 3 to 7 gaps per day—average 5 gaps.	0	9	7
Burning	Two coolies could clear fire-line round each gap and burn 3 to 6 a day and watch them till sundown.	0	3	7
Spreading ashes, staking, dibbling, etc.	Expenditure depends on many factors, e.g., size of gap, number of patches, etc., on an average one coolie did 2 to 4 gaps per day.	0	3	8
Cost of seed	One bag of all species at Rs. 1–8–0 per bag was sufficient for about 50 gaps.	0	0	6
First weeding	Three female coolies at 6 annas each did 9 gaps per day thoroughly, pulling weeds up by the roots just round the plants and cutting the remainder.	0	2	0
Second weeding	Do. do.	0	2	0
Third weeding (second year) ..	A heavier weeding	0	3	0
	Total ..	1	8	4

300. The amount actually spent on the experiment was considerably more than this, being Rs. 2–2–3 per patch. This was due to the fact that local labour was not available for the work and imported labour at 12 annas had to be used for most of the operations. The local coolies can turn out more work per day than these plains coolies, and it is probable that when done on a large scale it will be possible to reduce the cost to approximately Re. 1 per gap.

301. By this experiment the following facts were established :—

(1) The area of the burn should be as large as possible.

(2) The burn should not be too hot. The best result was obtained in a gap where a large flat file was made about 4 feet high and 20 feet in diameter, composed of small twigs and branches up to only about 3 inches in diameter. Large logs give too hot a burn. They are also more costly to cut up and stack.

(3) Fire-protecting each individual gap is expensive and difficult; it would be better to cut a fire-line round the whole area in which the gaps are being regenerated and to burn the piles early in the year, so that any escaping fire will be easy to control and will not do any damage.

(4) More tending is necessary than was done in the experiment though it is probable that fewer weedings will be required in the gaps than in an open regeneration area.

302. The results of this experiment look so hopeful that a further experiment on a larger scale is being carried out over 100 acres in 1930, and gap regeneration will be prescribed as an experimental measure in the selection felling working circle under this plan.

SECTION 4.—SPECIAL WORKS OF IMPROVEMENT UNDERTAKEN.

303. Since works of direct improvement of the forest such as regeneration, tending, etc., have been dealt with under the section on past management, this section will be confined to communications, buildings and other miscellaneous works.

304. *Roads and communications.*—The following statement shows the existing roads and paths in the Tunacadavu range with the date and cost of construction where ascertainable :—

Serial number and description.	Length.			Year of construction.	Cost of construction.			Remarks.
	M.	F.	C.		RS.	A.	P.	
1. Old cart-track from Kachithodu to the top of the Ayyasamimudi timber slide.	4	7	0	Not known.	Not known.			A very old cart-track. Portions are not now traceable, and only about one mile from Tekkadi to Ayyasamimudi is now in use.
2. Old cart-track from Sungam to Tellikal.	3	4	0	..	..			Not in use. Portions not traceable.
3. Old Top Slip Ghaut Road to Adivaram.	2	6	0	1868	4,009	0	0	Went out of use in 1924.
4. Cart-track from Sethumadi to the bottom of the Ayyasamimudi timber slide.	5	0	0	1910–11	Not known.			Unmetalled.
5. Road from Top Slip to Tunacadavu Ar.	2	3	0	1912–13	..			The first one mile 3 furlongs of this road have been merged in the new Top Slip-Anaipadi road. The remainder is now not used. The road was originally intended to go to Ulandiparai.
6. New Top Slip-Sethumadi Ghaut road.	6	6	0	1921—24	2,17,650	7	5	Metalled.
7. Extension from Top Slip to Anaipadi.	7	3	0	1926—28	1,10,337	0	0	Do.
8. Cycling path from Top Slip to Anaipadi.	2	6	0	1927	408	9	0	Old tram line converted.
9. Extension of (7) above to Sungam.	2	0	0	1930	3,764	6	0	Unmetalled.
10. Road from 21st mile 5th furlong of the Top Slip-Anaipadi road across the Tunacadavu Ar, and Michael's trace ridge into the Sichali pallam.	2	7	7·3	1929–30	8,657	8	0	Still being continued.

305. *Buildings.*—The following statement shows the forest buildings in the working plan area, with the dates of construction and the cost where ascertainable :—

Serial number and description.	Year of construction.	Cost of construction.		
		RS.	A.	P.
1. Rest-house at Mount Sutart	1885–86	3,000	0	0
2. Range Officer's quarters at Mount Stuart	1890–91	3,250	0	0
3. Kitchen to rest-house at Mount Stuart	1902	40	0	0
4. Fitter's quarters at Mount Stuart	1903	2,000	0	0
5. Range office at Mount Stuart	1905–06	689	10	6
6. Coolie lines at Mount Stuart	1922–23	6,149	2	11
7. Forester's shed at Anaipadi	1893–94	520	0	0
8. Mahout's line at Anaipadi	1901–02	1,793	0	0
9. Store-room at Anaipadi	1902–03	845	0	0
10. Deputy Ranger's quarters at Anaipadi	1899–00	751	0	0
11. Rest-house and out-houses, Tekkadi	1911–12	3,154	8	2
12. Range Officer's quarters and subordinates' lines, Tekkadi	1911–12	2,526	4	7
13. Rest-house at Top Slip	1926	9,450	0	0
14. Servants' quarters at Top Slip	1926	2,163	0	0
15. Motor-shed at Top Slip	1926	1,480	0	0
16. Range Officer's quarters at Top Slip	1926	6,262	0	0
17. Servants' quarters, Top Slip	1926	968	0	0
18. Assistant ranger's quarters, Top Slip	1926	5,693	0	0
19. Quarters for one depot-keeper at Top Slip	1926	5,693	0	0

Serial number and description.	Year of construction.	Cost of construction.		
		RS.	A.	P.
20. Range clerk's quarters at Top Slip	1926	5,693	0	0
21. Range office, Top Slip	1926	4,099	0	0
22. Five foresters' quarters, Top Slip	1926	6,831	0	0
23. Four forest guards' and 2 peons' quarters at Top Slip	1926	4,668	0	0
24. Workshop shed at Top Slip	1926	71	8	0

306. There are also the saw mill and buildings at Top Slip, which, it is hoped, will be sold very shortly, along with the machinery of the mill. They were erected in 1927 at the following cost :—

	RS.	A.	P.
(*a*) Erection of saw mill buildings	7,610	8	2
(*b*) Transport and erection of machinery	1,999	1	9
(*c*) Preliminary expenses before starting sawing	3,094	0	0
Total	12,703	9	11

307. *Elephant kraals.*—There are two double kraals for elephants at Anaipadi, which were constructed in 1916–17 at a cost of Rs. 495. A new kraal with three compartments and a concrete bottom under the floor was constructed at Sungam in 1930 at a cost of Rs. 1,078.

308. *Telephone line.*—There is a telephone line from Pollachi to Anaipadi, the total length of which is 22 miles. There are six instruments in all, as follows :—

Pollachi	1	Top Slip	2 *
Anamalai Farm	1	Anaipadi	1
Sethumadi	1		

It was constructed in two portions, viz.—

(*a*) Anamalai to Anaipadi—erected in 1912–13 by the Telegraph department and handed over to the Forest department in 1926–27 at a book value of Rs. 2,549–15–0.

(*b*) Anamalai to Pollachi—erected by the Forest Engineering department in 1926–27 at a cost of Rs. 4,923.

309. *Water-supply.*—An hydraulic ram was installed in 1911 on the Tunacadavu river above the old Mount Stuart saw mill, to supply the Mount Stuart buildings with water. This broke down in 1927 after Mount Stuart was abandoned.

310. A well at Anaipadi was sunk in 1919–20 at a cost of Rs. 827–5–7, but as it was unsuccessful, it was abandoned.

311. The spring below the road at Top Slip was built round and covered in at a cost of Rs. 100 in March 1922.

312. In 1927–28 a dam was built across one of the main streams in Karian Shola forming a reservoir, from which water was laid on in pipes to all the buildings at Top Slip. The total cost of this water system was Rs. 13,812–0–6

313. *Anti-malarial measures.*—The range headquarters at Mount Stuart, which had been moved from their original site near Waterfall between 1885 and 1890, on account of the malarious nature of the place, were also found to be exceedingly unhealthy in the fever season ; so much so, in fact, that the whole staff used to leave Mount Stuart and live at Sethumadi in the plains during the hot weather, and return only in June after the monsoon was well established. Under the orders of the Sanitary Commissioner, the Deputy Sanitary Commissioner visited Mount Stuart in November 1918 and made an inspection. He recommended in his report, that at Anaipadi, all undergrowth round the settlement for a mile radius should be cut, and the forest thinned so as to enable the subsoil to be drained as far as possible ; that wells provided with mosquito-proof covers should be sunk along the banks of the river for the use of coolies and for washing elephants, etc., and that during the dry season all stagnant puddles of water along the stream beds should be kerosined.

---

* One moved from Mount Stuart to the Range Officers' quarters.

314. In the case of Mount Stuart he suggested that, though a clearing of the forest and undergrowth round the settlement might reduce the feverishness of the place, a more desirable alternative would be to remove the whole settlement to Topslip which is higher and has not so many water-courses nearby. As the inspection was made during November when there was plenty of water and few malarial mosquitos, the Deputy Sanitary Commissioner was ordered to make a second inspection during the malaria season. This he does not seem to have done, and no action was taken on his report.

315. At the end of April 1920 Surgeon-General Giffard visited Mount Stuart with the Chief Conservator with a view to decide on measures to be taken to diminish the feverishness of the locality.

316. Acting under the Surgeon-General's orders, Doctor Menon of the King Institute, Guindy, conducted a malaria survey of Mount Stuart in July 1924, and submitted a voluminous report. The main conclusions arrived at were that Topslip was the best headquarters because—

(i) it had a higher altitude ;
(ii) it was better drained ;
(iii) owing to fewer streams in its vicinity, preventive measures could be less expensively carried out ; and
(iv) a good supply of drinking water would be available from Karian Shola.

317. The principle preventive measures prescribed were—

(i) jungle clearing and draining of swamps, and cleanliness round camps ;
(ii) proper location of buildings ;
(iii) personal prophylaxis by means of mosquito nets and quinine treatment ; and
(iv) segregation of the highly infected local aborigines from the labour brought up from the plains.

318. On this report an immediate shift of headquarters from Mount Stuart to Topslip was decided upon. New quarters for the staff, a new range office, and a forest rest-house were built, and a dam was constructed about 2 miles away in Karian Shola to form a reservoir of good water which was laid on in pipes to all the buildings.

319. Mount Stuart was vacated, and the new settlement occupied early in 1927. The cost of the new settlement, including the water system was Rs. 66,883.

320. The anti-malarial measures carried out at Topslip consisted of clearing the growth all round the settlement to a distance of about a furlong beyond the buildings, paving the bottoms of the streams with rough stone, and placing bags of sawdust soaked in kerosine in all the small streams and in the overflows from the stand pipes. The cutting of undergrowth and the replacement of sawdust bags have to be carried out several times in each season. The paving of the stream bottoms with rough stone is a measure of doubtful utility as it provides dark hollows between the stones shaded from direct sunlight which are ideal mosquito-breeding places. To be effective, the spaces between the stones should be filled in with fine rubble and cemented over. All members of the community are made to take quinine as a prophylactic regularly throughout the season, and the surbodinates have to use mosquito nets. There is little doubt that Topslip is much healthier than Mount Stuart was, though it is still very malarious in the hot weather. The annual sums spent on anti-malarial measures in the range since 1926 are as follows :—

	RS.	A.	P.		RS.	A.	P.
1926–27	1,730	5	0	1928–29	1,138	14	6
1927–28	2,671	14	0	1929–30	836	12	6

SECTION 5.—PAST YIELD.

321. *Timber.*—The following statement shows the quantities of timber extracted from the Mount Stuart and Tekkadi forests between 1917 and 1930. No timber was extracted during 1915–16 :—

Species.		1917–18.		1918–19.		1919–20.		1920–21.		1921–22.		1922–23.	
Scientific name. (1)	Vernacular name. (2)	Number of logs. (3)	Volume. (4)	Number of logs. (5)	Volume. (6)	Number of logs. (7)	Volume. (8)	Number of logs. (9)	Volume. (10)	Number of logs. (11)	Volume. (12)	Number of logs. (13)	Volume. (14)
			C.FT.		C.FT.		C.FT.		C.FT.		C.FT.		C.FT.
Tectona grandis	Teak (Tekku)..	23	393	..	..	1,078	30,849	252	5,935	1,770	55,726	2,216	64,256
Terminalia tomentosa	Karimarudu ..	148	6,641	69	1,886	1,520	11,563	225	4,921	818	20,635	1,330	36,741
Terminalia paniculata ..	Pillamarudu ..	29	1,199	8	239	178	4,563	105	2,170	470	10,792	671	14,010
Pterocarpus marsupium ..	Vengai ..	..	..	..	..	71	1,806	29	625	16	199	73	1,162
Dalbergia latifolia	Rosewood (Itti).	7	116	..	..	44	995	22	322	81	1,997	190	3,777
Lagerstrœmia lanceolata ..	Venteak ..	99	3,246	50	1,276	81	1,674	43	808	325	6,869	652	10,942
Xylia xylocarpa	Irul	..	..	4	79	2	45	5	81	17	338	50	981
Grewia tiliaefolia	Thadasu ..	..	..	..	..	13	273	24	399	206	3,386	515	7,658
Adina cordifolia	Manjakadambai.	..	..	..	..	19	589	..	..	89	3,577	88	4,797
Stephegyne parvifolia	Nirkadambai ..	1	37	..	..	20	623	16	343	23	469	54	1,118
Albizzia odoratissima	Karuvagai ..	..	..	..	..	38	1,090	2	24	74	1,617	102	2,253
Anogeissus latifolia	Vekkali ..	..	..	..	..	5	132	11	227	22	429	93	1,681
Bridelia retusa	Mulluvengai ..	..	..	..	..	..	..	..	..	22	295	64	755
Stereospermum xylocarpum ..	Vedankornai ..	..	..	..	..	..	..	..	..	16	279	61	713
Stereospermum chelenoides ..	Poopathri ..	..	..	..	..	..	..	..	..	..	..	14	326
Terminalia belerica	Thani	..	..	..	..	..	..	..	..	9	185	11	547
Miscellaneous		..	..	..	..	1	40	..	..	22	522	31	649
	Total ..	307	11,632	131	3,480	3,070	54,242	734	15,855	3,980	107,315	6,215	152,366

Species.		1923—24.		1924–25.		1925–26.		1926–27.		1927–28.		1928–29.		1929–30.	
Scientific names.	Vernacular name.	Number of logs. (15)	Volume. (16)	Number of logs. (17)	Volume. (18)	Number of logs. (19)	Volume. (20)	Number of logs. (21)	Volume. (22)	Number of logs. (23)	Volume. (24)	Number of logs. (25)	Volume. (26)	Number of logs. (27)	Volume. (28)
			C.FT.		C.FT.		C.FT.		C.FT.		C.FT.		C.FT.		C.FT.
Tectona grandis	Teak (Tekku)	1,624	43,416	2,362	69,263	1,675	46,662	1,298	37,656	1,025	31,092	2,196	54,969	1,726	40,803
Terminalia tomentosa	Karimarudu ..	949	27,847	865	26,399	498	16,379	232	6,326	530	18,410	1,046	33,049	931	24,040
Terminalia paniculata ..	Pillamarudu ..	393	11,506	545	14,492	403	12,767	199	5,675	546	16,890	511	13,455	640	16,407
Pterocarpus marsupium ..	Vengai ..	..	..	7	380	53	2,262	110	2,739	190	6,168	155	5,156	135	3,417
Dalbergia latifolia	Rosewood (Itti).	124	2,848	254	8,688	257	8,292	87	1,966	388	9,984	181	4,373	262	6,802
Lagerstrœmia lanceolata ..	Venteak ..	590	11,687	472	9,747	503	12,020	271	6,170	244	6,427	440	11,011	810	19,855
Xylia xylocarpa	Irul	160	3,773	112	2,131	119	2,541	..	..	..	..	32	553	43	612
Grewia tiliaefolia ..	Thadasu ..	69	1,199	44	771	..	..	70	1,406	248	2,937	230	4,661	414	7,644
Adina cordifolia	Manjakadambai.	146	8,822	113	5,044	33	1,231	39	1,956	16	582	94	2,939	122	4,746
Stephegyne parvifolia	Nirkadambai ..	47	1,159	26	659	8	261	..	..	..	..	..	..	2	30
Albizzia odoratissima ..	Karuvagai ..	18	480	19	480	5	175	103	2,785	116	2,496	40	1,147	136	3,217
Anogeissus latifolia	Vekkali ..	18	374	12	273	23	471	..	..	37	530	..	..	..	..
Bridelia retusa	Mulluvengai ..	14	237	6	101	..	..	..	..	..	..	..	..	..	..
Stereospermum xylocarpum ..	Vedankornai ..	18	377	54	950	14	260	..	..	26	382	28	408	44	739
Stereospermum chelenoides ..	Poopathri ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Terminalia belerica	Thani	..	..	..	..	1	25	..	..	..	..	..	..	..	..
Miscellaneous		41	2,290	9	411	10	393	..	..	32	435	65	563	12	420
	Total ..	4,211	116,015	4,900	139,789	3,602	103,739	2,409	66,679	3,398	96,333	5,018	132,284	5,277	128,732

322. *Yield from the Ulandi and Palakadavu blocks.*—The past yield from the Ulandi and Palakadavu blocks is shown in the following statement :—

Species.		1912–13.		1913–14.		1919–20.		Remarks.
Scientific name.	Vernacular name.	Number of logs.	Volume.	Number of logs.	Volume.	Number of logs.	Volume.	
			C.FT.		C.FT.		C.FT.	
Tectona grandis ..	Teak (Tekku).	286	*19,873	..	..	210	†28,922	* From Coupe I, Ulandi.
Dalbergia latifolia ..	Rosewood (Itti).	144	*10,092	..	..	..	..	† From 111 trees marked near Palakadavu.
Pterocarpus marsupium.	Vengai ..	46	*1,946	2	83	..	..	
Terminalia tomentosa.	Karimarudu.	97	*3,580	3	66	..	..	
Terminalia paniculata.	Pillamarudu.	168	*8,093	1	24	..	..	
Lagerstrœmia lanceolata.	Venteak ..	172	*3,277	..	..	..	..	
	Total ..	813	46,861	6	173	210	28,922	

Some 28 teak trees and 3 *Dalbergia latifolia* trees yielding 2,632 cubic feet and 214 cubic feet respectively are reported to have been extracted in the course of clearing the Cochin boundary. Thirty-six teak logs and one *Dalbergia latifolia* log yielding 2,762 cubic feet and 123 cubic feet respectively are stated to have been extracted from Coupe IX Ulandi, but the dates of the above fellings are not known.

323. *Teak poles.*—The following numbers of teak poles have been extracted between the years 1917 and 1930 :—

Year.	1917–18.	1918–19.	1919–20.	1920–21.	1921–22.	1922–23.	1923–24.	1924–25.	1925–26.	1926–27.	1927–28.	1928–29.	1929–30.
Number of teak poles.	..	..	120	..	..	323	305	Not known.	Not known.	Not known.	Not known.	5,478	2,995

324. *Spokes and felloes.*—The following numbers of teak spokes and felloes have been extracted between 1917 and 1930 :—

Year.	Felloes.	Spokes.	Sets of 24 spokes and 12 felloes.	Remarks.
1917–18	4,926	8,592	= 358 sets.	One set—11 cubic feet.
1918–19	564	1,104	= 46 ,, plus 12 felloes.	
1919–20	3,972	7,944	= 331 sets.	
1920–21	3,240	6,480	= 270 ,,	
1921–22	1,894	3,648	= 151 ,,	
1922–23	..	..	..	No conversion during this year.
1923–24	906	1,812	= 75½ sets.	
1924–25	2,400	4,800	= 200 ,,	
1925–26	306	612	= 25½ ,,	
1926–27	5,334	10,668	= 444½ ,,	
1927–28	5,058	10,116	= 421½ ,,	
1928–29	3,612	7,224	= 301 ,,	
1929–30	2,646	5,292	= 220½ ,,	

325. *Elephants.*—The numbers of elephants captured, along with the numbers sold and the numbers of casualties in each year since 1916 are given below :—

Year.	Number of elephant captures.	Value.	Number sold.	Value.	Number of casualties.	Value.
		RS.		RS.		RS.
1916–17	6	(a)	2	2,740	3	(a)
1917–18	15		4	9,850	4	
1918–19	16		9	23,025	3	
1919–20	5	(b) 9,500	..	..	8	(c) 17,500
1920–21	12	21,300	5	14,875	8	14,000
1921–22	5	18,000	..	..	2	4,000
1922–23	7	18,800	9	16,400	5	18,000
1923–24	1	1,000	1	4,600	6	21,000
1924–25	5	13,900	..	..	3	5,400
1925–26	8	10,700	4	3,200	2	4,500
1926–27	10	12,800	4	5,800	5	6,800
1927–28	5	7,600	4	3,500	3	5,900
1928–29	6	10,800	7	12,300	3	5,400
1929–30	14	(d) 13,400	3	5,050	7	(e) 3,100

(a) No information available.

(b) Value of one elephant not known.

(c) Value of two casualties not known.

(d) Value of 10 out of the 14 elephants only. The other four were casualties and no values were fixed.

(e) Value of three of the casualties only. The values of the other four were not fixed.

SECTION 6.—PAST REVENUE AND EXPENDITURE.

326. *Past revenue.*—The following statement gives a summary of the revenue realized during the period of Mr. Wood's working plan :—

Year.	Sale of timber.	Bamboos.	Miscellaneous receipts.	Total.
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
1919–20	73,598 8 4	..	2,236 4 2	75,834 12 6
1920–21	60,482 13 9	200 0 0	405 14 7	61,088 12 4
1921–22	2,02,557 6 6	675 0 0	561 5 4	2,03,793 11 10
1922–23	2,42,104 6 1	150 0 0	1,515 12 11	2,43,770 3 0
1923–24	1,76,247 5 10	515 0 0	3,488 11 6	1,80,251 1 4
1924–25	1,08,144 8 4	715 0 0	3,350 1 1	1,12,209 9 5
1925–26	1,36,104 8 9	705 0 0	4,529 5 10	1,41,338 14 7
1926–27	1,86,183 8 11	510 0 0	1,116 11 1	1,87,810 4 0
1927–28	2,12,527 5 1	1,210 0 0	722 8 10	2,14,459 13 11
1928–29	1,88,400 15 2	2,500 0 0	1,230 12 3	1,92,131 11 5
1929–30	1,90,511 6 11	1,500 0 0	1,263 12 0	1,93,275 2 11
Total ..	17,76,862 13 8	8,680 0 0	20,421 3 7	18,05,964 1 3

327. *Past expenditure.*—The following statement of past expenditure has been extracted from the commercial audit balance sheets, and is given for what it is worth :—

Summary of Past Expenditure in the Mount Stuart Commercial concern.

Year. (1)	Regeneration operations including tending and maintenance. (2)	Fire protection. (3)	Cost of producing logs, scantlings, spokes and felloes. (4)	Lease payment. (5)	Feed and keep of livestock which represents cost of dragging. (6)	Repairs to roads, etc. (7)	Repairs to buildings. (8)	Pay and allowances. (9)
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
1919–20	3,114 6 0	1,798 13 0	19,510 5 9	2,500 0 0	30,420 6 3	1,974 7 11	960 4 0	28,605 9 7
1920–21	2,857 7 7	738 13 0	22,994 15 1	1,250 0 0	26,647 2 11	2,607 9 8	713 6 2	24,149 3 0
1921–22	3,270 5 2	1,450 8 0	92,347 8 2	5,000 0 0	20,849 13 4	2,904 8 0	484 6 0	24,666 13 3
1922–23	8,263 15 6	193 10 0	102,726 8 4	5,000 0 0	23,821 5 3	8,345 0 10	1,701 7 7	22,640 11 0
1923–24	12,953 1 3	541 8 0	110,768 6 10	5,000 0 0	22,660 4 4	10,287 10 7	3,105 12 0	22,953 1 5
1924–25	11,180 14 10	469 3 6	88,500 4 1	5,000 0 0	23,260 4 6	12,810 5 3	1,618 5 4	22,736 1 4
1925–26	17,676 8 6	413 9 0	93,811 12 6	2,500 0 0	17,110 10 4	13,668 1 0	2,185 0 0	10,470 6 6
1926–27	15,006 0 0	642 4 0	60,411 6 2	2,500 0 0	22,166 15 1	5,164 10 0	1,035 0 0	12,437 2 0
1927–28	10,373 7 9	777 11 6	79,432 9 0	2,500 0 0	18,145 4 3	11,217 4 0	1,307 0 0	8,711 14 6
1928–29	8,736 5 3	1,084 5 0	90,372 15 11	2,500 0 0	22,148 10 2	13,466 4 0	822 15 0	8,763 4 0
1929–30	10,096 7 4	1,743 13 0	92,534 2	2,500 0 0	16,435 10 9	10,702 4 0	727 12 0	9,412 0 6
Total ..	1,03,528 15 2	9,853 2 0	8,53,410 13 0	36,250 0 0	2,43,666 7 2	93,148 1 3	13,660 13 1	1,95,546 3 1

Year.	Consignment charges. (10)	Elephant capturing operations. (11)	Overheads including direction charges of Chief Conservator. (12)	Interest and depreciation on roads, etc. (13)	Miscellaneous charges. (14)	Overheads and interest on regeneration plantations. (15)	Total. (16)
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
1919–20	....	1,942 15 2	....	....	5,299 13 2	....	96,127 0 10
1920–21	....	2,503 12 7	....	....	2,475 12 7	....	86,938 2 7
1921–22	11,395 5 6	7,961 1 9	25,037 5 2	2,467 3 11	2,638 15 8	....	2,00,473 13 11
1922–23	3,881 8 0	7,507 7 2	28,295 13 8	3,515 12 3	2,745 15 11	....	2,17,638 12 6
1923–24	2,235 15 0	3,846 15 8	30,854 14 11	3,842 12 3	4,569 10 1	....	2,33,620 0 4
1924–25	....	2,816 11 4	33,810 14 7	539 0 0	6,420 7 0	....	2,19,162 7 9
1925–26	7,786 11 9	3,920 3 0	15,828 7 10	2,913 13 0	5,706 9 3	30,913 4 3	2,24,905 0 11
1926–27	7,355 1 10	6,401 10 2	23,228 12 5	2,186 8 0	6,367 1 11	30,958 12 11	1,95,861 4 6
1927–28	1,402 1 9	5,879 6 0	32,208 4 4	2,491 8 0	7,317 15 2	29,519 5 0	2,11,283 11 3
1928–29	1,175 9 0	4,139 1 0	25,109 3 7	2,491 8 0	3,930 7 3	27,150 2 4	2,11,890 10 6
1929–30	5,319 11 0	5,391 12 6	21,083 11 0	2,622 0 0	....	31,203 10 2	2,09,772 13 5
Total ..	40,551 15 10	52,311 0 4	2,35,457 7 6	23,070 1 5	47,472 12 0	1,49,745 2 8	21,07,673 14 6

NOTE.—From the year 1925–26 the expenditure in columns (5), (9) and (14) has been equally divided between regeneration and exploitation and is included in column (15). Columns (5), (9) and (14) show only half the actuals. The above figures are as far as possible taken from the Audit reports of Mount Stuart Working Circle. Those for the year 1920–21 are for nine months only, i.e., from July 1920 to March 1921.

328. The following points are of interest with regard to the above statement of expenditure. The column "Pay and Allowances" includes the cost of junior Assistant Conservators who have frequently been attached to the division for training. Such expenditure should correctly be charged to "General Direction" for the whole presidency.

329. The division of the overheads in columns (5), (9) and (14), equally between regeneration and exploitation has confused the issue and made it impossible to see what the actual expenditure on these items is. It is moreover an incorrect practice since regeneration is not now regarded as a capital work, but as part of the unavoidable incidental expenditure on exploitation, which is undoubtedly the correct view. For this reason the item of interest on the plantations charged in column (15) is also an unfair charge, quite apart from the fact that the capitalized value of the plantations on which this interest has been calculated, appears to have been arrived at in a very arbitrary fashion.

330. Column (13) represents interest and depreciation on roads. It is usually regarded as incorrect to depreciate the value of the roads since in actual practice the roads do not depreciate, as they are repaired and maintained. The costs of maintenance represent the depreciation value, and if depreciation is charged as well as maintenance costs, the same item is really being charged twice over.

331. The rate of interest which is charged in the various overheads is fixed by Government from time to time, and is usually between 5 per cent and 7 per cent. The subject of the rates of interest chargeable in an industry like forestry which deals with long periods of time is one which has, in spite of much ventilation, never been satisfactorily settled. There is no space to go into this question here, but it is generally recognized that a low rate of 2½ to 3½ per cent is probably about correct, and if this rate were applied to the above figures, a more favourable result would be obtained.

332. The value of the overheads has in many cases been fixed arbitrarily, and there has been some disagreement about the amounts apportioned to the Mount Stuart concern. The confusion of these overheads with the actual items of expenditure makes it very difficult to obtain an accurate view of the financial position.

CHAPTER VI.—STATISTICS OF THE GROWTH AND YIELD.

SECTION I.—STATISTICS COLLECTED PREVIOUS TO THE PREPARATION OF THE PRESENT PLAN.

333. Very few statistics have been collected in the past regarding the rate of growth of timber species at Mount Stuart.

334. Mr. Wood, during the preparation of his working plan, made stem analyses of two teak trees and one *Dalbergia latifolia* tree, the results of which are tabulated below. (The full record of the stem analyses is to be found in the box containing the Mount Stuart Working Plan records in the Working Plan Conservator's office.)

Teak tree No. I—Age, 130 years—Total height of tree, 96 feet.

	Age in years.												
	10	20	30	40	50	60	70	80	90	100	110	120	130
Height (in feet).	1·7	31·5	49·7	61·0	66·9	70·9	74·1	76·6	78·9	80·8	82	..	..
Diameter at base under bark (in inches).	2·2	3·7	5·8	8·5	11·3	14·9	18·9	22·5	25·6	28·1	30·2	32·0	33·6
Volume (cubic feet of stem-wood).	..	1·6	4·1	7·7	13·5	21·0	30·6	42·3	58	77	99	122	151
Mean annual increment (cubic feet).	..	0·08	0·14	0·19	0·27	0·35	0·44	0·53	0·65	0·77	0·92	1·02	1·16
Current annual increment (cubic feet).	0·08	0·17	0·30	0·45	0·63	0·84	1·08	1·32	1·65	1·98	2·32	2·66	3·12

Girth over bark four feet from the ground—8 feet 9 inches.

Teak tree No. II—Age, 151 years. Total height of tree, 100 feet.

Height of bole, 87 feet.

	Age in years.														
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Height (feet)	22·5	42·1	56·9	66·4	72·3	76·5	79·9	82·7	85·6	88·5	91·0	93·8	96·3	98·5	100
Diameter at base under bark (inch).	3·2	6·2	9·0	11·3	13·2	14·8	16·2	17·6	19·0	20·2	21·6	22·7	23·8	24·9	25·9
Volume of stemwood in cubic feet.	..	2·0	6·0	12·8	21	30	40	51	63	76	90	105	120	136	152
Mean annual increment (cubic feet).	..	0·10	0·20	0·32	0·42	0·50	0·57	0·64	0·70	0·76	0·82	0·88	0·92	0·97	1·01
Current annual increment (cubic feet).	0·1	0·2	0·55	0·75	0·85	0·95	1·05	1·15	1·25	1·35	1·45	1·5	1·55	1·6	1·65

Girth over bark at 4½ feet from the ground—7 feet 10 inches.

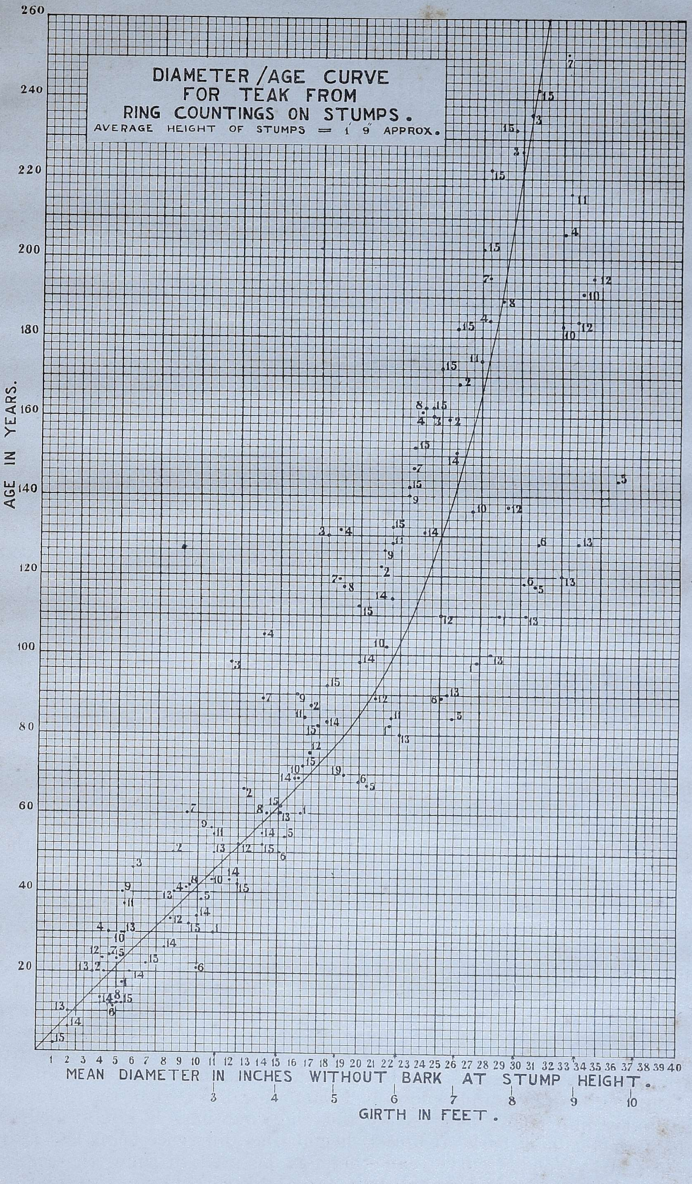
Dalbergia latifolia tree.—Age 122 years—Total height of tree, 150 feet.

	Age in years.											
	10	20	30	40	50	60	70	80	90	100	110	120
Height (feet)	8·2	18·0	32·0	57·0	73·8	80·0	84·2	88·3	92·6	96·8	100·2	104·4
Diameter at base over bark (in inches).	3·0	6·0	9·0	12·1	15·1	18·2	21·3	23·7	25·9	27·6	29·1	30·2
Volume of stemwood (cubic feet).	0·8	1·8	4·0	9·2	19·1	36	56	78	99	122	143	165
Mean annual increment (cubic feet).	0·08	0·09	0·13	0·23	0·38	0·60	0·80	0·98	1·10	1·22	1·30	1·37
Current annual increment (cubic feet).	0·09	0·16	0·37	0·76	1·34	1·85	2·09	2·19	2·21	2·21	2·20	2·19

There is little doubt that the trees for which these stem analyses were made, were exceptionally well grown, and that the general rate of growth in the forest is considerably slower than that exhibited by them. It is interesting to note that the culmination point of the current annual increment is not reached in the case of either of the teak trees analysed, while in the *Dalbergia latifolia* tree, it is reached at an age of about 95 years. *Dalbergia latifolia* appears to grow considerably faster than teak in middle age, and slower when it is either very young or very old.

335. Mr. Wood also carried out ring countings on the stumps of 15 felled-teak trees, and constructed a curve showing the diameter increment of teak at stump height under bark. Unfortunately the value of this curve is greatly diminished by the fact that the average heights of the stumps were not recorded, nor were any measurements taken to correct the curve to breast height (4 feet 6 inches). This curve which has been re-drawn from the same plotted points is reproduced on the opposite page. Rough measurements of the reduction in girth from " stump height" (taken at 1 foot 9 inches from the ground), to breast height, combined with measurements of bark thickness for plantation teak in sample plots at Nilambur indicate that the diameter under bark at stump height (as given by the ring countings) is almost identical with the diameter *over* bark at breast height, the difference being less than 3 per cent. Mr. Wood's curve can therefore be used to show the approximate diameter increment at breast height over bark without any great error. The general indication is that Mr. Wood's curve was compiled from stumps of trees in an unusually good locality, and that the rate of growth shown by the curve is greater than the average rate of growth for the whole forest.

336. Apart from the above, no statistics have been recorded in the past which give any indication of the rate of growth of timber trees at Mount Stuart.



DIAMETER / AGE CURVE FOR TEAK FROM RING COUNTINGS ON STUMPS.

AVERAGE HEIGHT OF STUMPS = 1′ 9″ APPROX.

SECTION 2.—STATISTICS COLLECTED DURING THE PREPARATION OF THE PRESENT WORKING PLAN—ENUMERATION AND TOPOGRAPHICAL SURVEY.

337. A 100 per cent enumeration of the whole of the workable deciduous forest in the Mount Stuart, Tekkadi and Ulandi blocks, combined with a detailed topographical survey of the area on a scale of 12 inches to a mile was carried out between 1927 and 1930. The method of executing this survey is described below.

338. *Base-lines.*—A system of base-lines was laid out roughly on the four-inch scale map after reconnoitering the area and selecting suitable locations for them. The system consisted of a series of closed traverses linked together and arranged so that the lines took advantage of existing topographical features in such a way that they were as level as possible, following the lie of the country, and at the same time were conveniently spaced so that strips run at right angles to the lie of the country would be of a convenient length (about 60 to 90 chains). These base-lines were then chained and pegged, traversed by theodolite, and levelled throughout by " Dumpy level ". Some short lengths of the base-lines, where the country was too steep and broken for chaining, were surveyed by a ' Stadia ' instrument which was calibrated so as to give vertical and horizontal coefficients which, when multiplied into the staff readings, gave the vertical differences in elevation, and the horizontal distances, direct. This instrument saved a great deal of time in such difficult country. The readings were all checked by being repeated from the back and forward stations.

339. The starting point of the base-line system was the Mount Stuart survey mark (an " Intersected Point " on the Minor Trigonometrical Survey of India), and for want of any other survey points or bench marks within the area, the elevation of this point was taken as the datum for the levels of the whole system. After surveying and checking the angular closures the traverses were computed by the method of latitudes and departures, and the joining errors, if within the permissible limits were distributed arithmetically in proportion to the distances between stations. The traverses were then plotted by co-ordinates on the scale of 12 inches to the mile, and parallel strip lines six chains apart were laid out on a given bearing chosen so that the strips would cross the steepest gradients of the country as nearly as possible at right angles. A list of the starting points and meeting points of these strips on the base-lines was then prepared.

340. Levels were also reduced throughout the whole of each traverse and the joining error in elevation determined, and distributed if within the permissible limit.

341. A high degree of accuracy in the surveying of the base-lines was not attempted. The following errors were permitted, and any work which showed errors in excess of these amounts was repeated :—

	Permissible error.	Remarks.
Chaining	Fifty links per 100 chains.	This was usually easily maintained and when the traverse calculations indicated a closing error in excess of this amount, it would always be traced to mis-counting the pegs.
Angular measurement.	One minute of angle per ten stations.	This was always easily maintained, the average error being only one-fifth of this amount.
Dumpy levelling ..	One foot per mile of line.	This was usually easily achieved.
Stadia lines—distance and elevations.	One per cent ..	Easily achieved if the stations were not too long and near the ground, when, on hot days, atmospheric refraction caused greater errors. The total length of base lines run in the course of the enumerations was 102·6 miles.

342. *Topography.*—The topography was done using the "Topographical Abney Level" (graduated in feet, rise or fall per chain of horizontal distance), and the "trailer tape." The latter consisted of an ordinary steel band graduated in links, with an additional portion called the trailer, which was graduated so that the whole chain plus the trailer up to a given reading, would be the slope equivalent of one horizontal chain. Thus if the topographical Abney gave a reading of 25, by holding the trailer at the figure 25, and chaining parallel to the slope of the ground, the horizontal distance would be exactly one chain. This avoided the necessity for any reference to tables for slope correction of distances.

343. From the strip list, prepared as described above, the actual starting point of each strip on the ground could be determined by measuring from the nearest base-line peg. A compassman then cut a straight line through the forest on the given bearing until he met the other base-line.

344. The topographer followed him, and fixed chain points along the strip line with the trailer tape, levelling them with the topographical Abney as he went. He determined his starting elevation from the nearest base-line peg, and fixed the position of all contours, streams, paths, and other topographical details on the strip line as he proceeded. He sketched in the topography on either side of the strip line on a previously prepared "topo strip" on which guide lines one chain apart were ruled, and all chain points on the strip line were pricked on the scale of 12 inches to a mile. The contours were drawn at 20-foot intervals. When the topographer reached the other base-line, he "tied in" to the nearest peg, and noted his actual hitting point, error in elevation and in length of strip. These errors were all entered in the strip list. The permissible errors were fixed as follows :—

Measurement.	Permissible error.	Remarks.
Length of strip ..	One per cent ..	Always easily achieved, as the trailer gives accurate correction for slope.
Hitting point of strip on base-line.	One chain to either side per mile of strip.	Very frequently exceeded, the chief cause of error being local magnetic attraction which is frequently encountered at Mount Stuart. Such local magnetic fields are so large and increase in force so gradually that it is difficult for the compassman to notice them and correct his bearing. This is especially noticeable in the vicinity of Tekkadi, where the Pandaravarai Malái, and Periyakathadi Mudi *massif* acts as a strong magnet, deflecting the compass as much as three to four degrees when close to the foot of the mountain.
Elevation	Ten feet per mile ..	Frequently exceeded, necessitating repetition of work. Usual causes are either bad adjustment of the Abney, or misreading the scale on the instrument.

345. The permissible error for the meeting of sketched topographical details at the edges of adjacent strips was fixed at one chain taken perpendicular to the direction of the contour, stream or other feature. In open forest this was easily achieved by an experienced and careful topographer. Much of the country however was very difficult, consisting of dense undergrowth and fallen bamboos in which it was impossible to see more than half a chain, and the errors at the edges of the strips, three chains from the compass line, frequently exceeded one chain. Much time was spent by the topographers in crawling through the undergrowth to ascertain the lie of the country so as to avoid and rectify such errors, but it was impossible to eliminate them all without incurring prohibitive expenditure. As it was, the fact that the bamboos had flowered over most of the area and had fallen before the mapping was done greatly impeded the work, and must have almost doubled the cost of it. In clear jungle where the bamboos had not flowered a compassman could cut 100 chains of line and a

mapping party could map and enumerate 40 to 50 acres, whereas in places where the bamboos had flowered, the rates of progress were only 25 to 40 chains of line, and 15 to 25 acres of mapping and enumeration.

346. *Enumeration.*—Following the topographer were two enumerating foresters, one on each side of the line, and each forester had three coolies with callipers. The foresters enumerated a strip three chains wide, the width being estimated. The outermost trees enumerated in each strip were blazed, so that when the next strip was being run, all trees up to the blaze marks could be enumerated, thus avoiding any omission or overlapping. The coolies measured the minimum diameter of each tree at breast height with the callipers and the forester noted the species, the girth shouted out by the coolie, and the length of merchantable logs in the tree, and recorded them in a printed enumeration form by entering the estimated height opposite the species letter in the column for the particular girth class. He also noted whether the tree was sound, unsound or dead. (Minimum diameters were measured instead of mean diameters so as to obtain a definite measurement that could be checked on each tree. The difference between the minimum and maximum diameters of a tree was frequently as much as 2 feet, and hence without having a definite measurement on each tree, no check on the callipering would have been possible. Statistics were collected for converting minimum callipered girths to mean girths—vide paragraph 363 below.) All trees of 8 feet girth and under were measured by callipers. Trees of over 8 feet in girth were measured with a tape. All species were enumerated, whether at present saleable or not. The number of bamboo clumps containing more than about 12 saleable culms was also counted. At the end of every 5 chains on the strip line, the topographer informed the enumerating foresters, and they enumerated up to a line at right angles to the 5-chain point, and closed the plot by drawing a line across the enumeration sheet. They then recorded particulars for the plot regarding the quantity of regeneration and advance growth of each species, a brief description of the undergrowth, the density of stocking, the depth of the soil (as judged by the height growth of the trees), the type of soil, and its drainage, and judged whether the plot was suitable, unsuitable, or doubtfully suitable for planting with teak.

347. A running check was carried on right through the whole enumeration by re-enumerating plots with the two enumerators interchanged. The proportion of checking was varied according to the capabilities and accuracy of the enumerators, and ranged from one plot in eight or less for bad enumerators, to one plot in twenty for good enumerators, the average being about one in twelve (about 8·3 per cent). The estimation of heights was the point in which most errors were made, and enumerators were each provided with a Christen's hypsometer with which to check their height estimates. When re-enumerating plots as a check, nearly all heights were measured by hypsometer. The checks were compared with the original enumerations, and if any man's work was found insufficiently accurate, it was repeated.

348. The total area mapped and enumerated in Mount Stuart, Tekkadi and Ulandi blocks, including some small areas of evergreen forest, and a check enumeration in Karian Shola was about 19,925 acres involving about 415 miles of strip lines.

349. *Compilation of maps and enumeration figures.*—The compilation of the maps and enumeration figures was done during the monsoon, and also during April and May, when the Mount Stuart forests became too malarial for economical working.

350. The method of constructing the maps is as follows: The base-line system is accurately plotted and the starting and actual hitting points of the strips are marked and the strip lines drawn. The strips mapped in the field are then cut out and stuck on to the base-line plotting exactly in the positions they were run on the ground. Any error in the length of the strip is adjusted

by cutting the strip in the middle. After pasting all the strips on the base-line plotting, a tracing is taken in which the following errors are all adjusted :—

(*a*) Any error in the length of the strip is adjusted by moving the contours away from or towards the point where the strip had to be cut, according as the edges overlap or are separated by a gap. All streams, paths, rocks, and all other details except contours are then traced in.

(*b*) Any error in the elevation at the hitting point of the strip is then distributed along each strip by correcting the elevation figures on the cut off pieces proportionately to the distance from the starting point, and the crossing points of the contours on the strip lines are altered accordingly.

(*c*) Contours are then traced in, adjusting at the same time any discrepancies found at the edges of the adjacent strips. Portions of the map outside the actual area mapped by the above method are enlarged from the survey of India sheets and dotted in approximately. A final cloth tracing is taken off this first paper tracing on which all the adjustments have been made.

351. A " cover map " showing the positions of all the strips and 1½ acre rectangles is also prepared. For this purpose a tracing of the plotted base-line system is taken before the strips are pasted on, and the starting points only are marked. For the sake of appearance the strip lines are drawn parallel and equidistant, and the cross-lines of the plots are drawn at 5-chain intervals, the length of the last plot being checked with the actual chainage as recorded in the enumeration sheets. Cover maps may be either printed separately or along with the topographical map. In the case of the Mount Stuart maps they have been printed together to facilitate the compilation of working plan data and the preparation of stock maps, etc.

352. The enumerations were compiled at the same time by working out the volume of saleable timber in each tree enumerated from volume tables compiled as described below. These volume tables are the weak point of the whole enumeration, since sufficient data were not available for accurate tables to be compiled. After working out the volumes of the trees, the total volumes of timber over 3 feet, 6 feet and 7 feet minimum callipered girths * were worked out separately for teak, *Dalbergia latifolia* and " other saleable species " which included *Terminalia tomentosa*, *Terminalia paniculata*, *Lagerstrœmia lanceolata*, *Pterocarpus marsupium*, *Xylia xylocarpa*, *Adina cordifolia* and *Grewia tiliæfolia*. These were worked out separately for the Clear-felling and the Selection-Felling Working Circles, and are quoted in Part II under the chapters relating to the respective working circles. The figures were posted on cover maps as required, for determining the size, location, and yield of the coupes laid out for future working.

353. A " suitability map " was also completed by entering on a cover map the information recorded on the enumeration sheets regarding the suitability of each plot for planting with teak, and from this the most suitable large compact blocks for planting with teak were marked out and assigned to the Clear-felling Working Circle. The remainder of the workable deciduous forest was assigned to the Selection-Felling Working Circle.

354. The advantages of such a detailed enumeration and survey by the above method are numerous. In the first place detailed large-scale maps of a sufficient degree of accuracy have been prepared, and will serve for many years to come. The old 4-inch scale maps prepared in 1894 on which all work had been done up to date were found to be very inaccurate and unsatisfactory for such intensive working as was being done at Mount Stuart.

355. The value of the enumeration has been somewhat reduced by the fact that the volume tables which were used for calculating the volume of the growing stock are of doubtful accuracy, insufficient data being available for their accurate compilation. However, this has not affected the usefulness of the enumeration as far as the regulation of the yield is concerned, and it has been possible to adjust the fellings very accurately so that an equal annual outturn will be obtained and at the same time the present possibility of the forest will be

---

* The callipers were calibrated to read directly in girths and not in diameters.

worked up to, with a slight margin of safety on the conservative side. If the actual volume outturn obtained from the coupes is found to be greater than that foretold by the enumeration, it will be due to the inaccuracy of the volume tables. This however will not affect the regulation of the yield if the original volume tables are used when marking for felling.

356. Provision is made in Part II of this plan to collect statistics for the correction of the volume tables, and also for the determination of the rate of growth of timber species in natural forest, and if these statistics are applied to the present enumeration, it should not be necessary to do re-enumerations at the next three or four revisions of the plan.

357. Detailed stock maps are being compiled from the enumeration figures for all Timber Working Circles in the deciduous forest. One great advantage of this method of enumeration is that in the event of a demand arising for any particular species of tree (e.g., *Anogeissus latifolia* for tool handles, or *Givotia rottleriformis* for pencils—to mention two possibilities), it will be immediately possible to compile a " cover map " from the enumerations showing exactly what quantities of the particular species are available, and in what localities, and a complete scheme of working can be drawn up without any further field work.

358. An abstract of the enumeration figures for the whole of the deciduous forest is given in Appendix A, and in Chapter II, and further abstracts for each working circle will be found in the respective chapters in Part II. The original enumeration sheets and the sheets of volumes of timber deduced from them are kept in the Mount Stuart Working Plan Record Box in the Working Plan Circle office.

SECTION 3.—ENUMERATIONS IN THE PALAKADAVU BLOCK.

359. The Palakadavu block was included in the working plan area too late for an enumeration and topographical survey to be carried out in the same way as was done for the other portions of the deciduous forest. Consequently a rough stock map was made for the area on the 4-inch scale map and the volume of timber available was ascertained from sample enumeration strips, 8 chains wide, covering 17·2 per cent of the area. The forest was divided into the following types :—

Type T-1—Areas containing a considerable quantity of teak (over about 400 cubic feet per acre).

Type T-2—Areas of deciduous forest containing scattered teak trees here and there.

Type D-1—Areas of good deciduous forest without any teak.

Type D-2—Areas of very poor deciduous forest, usually on high rocky ground, not containing any timber of saleable size.

Type S.E.—Areas of semi-evergreen forest, containing a proportion of useful species (chiefly *Terminalia paniculata* and *Lagerstrœmia lanceolata*).

Type E—Areas of pure evergreen forest (shola)

360. The enumerations in the sample strips were done in types T-1, T-2, D-1, and S.E., but no enumerations were done in the D-2 and E types as it is not expected that these types will be worked. The average stocking per acre of useful timber species was ascertained from the enumerations and a rough estimate of the total workable growing stock of the forest has been arrived at by multiplying the number of cubic feet per acre for each type by the total area of that type. An abstract of the enumeration will be found in Chapter III of Part II of the plan (paragraph 539).

SECTION 4.—ENUMERATION IN KARIAN SHOLA.

361. In 1926, a 50 per cent enumeration with topographical survey was carried out by the subordinates of the Logging Engineering branch. This enumeration has proved on checking to be so inaccurate as to be quite valueless. The topographical map, although found to contain many errors, is on the whole sufficiently accurate to be incorporated in the 12-inch maps of the working plan area.

SECTION 5.—PREPARATION OF VOLUME TABLES.

362. A search was made through the existing felling registers (old Form 7) to find whether the breast-height girths of the standing trees had been recorded in any of them. (Many of the registers were found to be missing, and were said to have been eaten by white-ants at Mount Stuart before the headquarters were shifted to Top Slip.) Of the remaining registers, it was found that in those of the years 1906–07, 1912, 1928–29 breast-height girths were recorded. Figures were tabulated showing the volume of timber from each tree by 1-foot breast-height girth classes, and 10-foot 'height' classes ('height' in this connexion meaning the total length of saleable logs from each tree). The average volume outturn for each girth-height class was then worked out and curves plotted for each girth class showing the relation between height and volume, the points on the curves being based according to the number of trees represented by each. From these curves a second set of curves was prepared showing the relation between girth and volume for every 5-foot height class, and the final volume table was read off from this second set of curves. Very great variation was found in the volumes of trees within any given girth and height class, and the measurements of a large number of trees are necessary in order to obtain results of any accuracy. The measurements of 867 teak trees, 386 *Terminalia tomentosa* trees and 123 *Terminalia paniculata* trees were obtained from the sources mentioned above. The curves for teak were fairly even and were certainly reliable for trees between 4 feet and 10 feet in girth. Outside these limits the figures in the volume tables are not reliable. The volume tables are given in Appendix F. It was found that the data for *Terminalia tomentosa* and *Terminalia paniculata* were insufficient for compiling volume tables, as it was impossible to obtain smooth curves from so few trees. In order to work out the volumes of species other than teak in the enumeration, a series of tables were deduced from the teak table by applying correcting factors for each girth class. These factors were calculated from the measurements of trees of the various species made by Mr. Wood, and recorded in his working plan. A subsequent statistical analysis of the data upon which these tables were based indicates that though the tables themselves differ from each other considerably, the variation in the basic data is so great as to render the differences between the tables for the various species not significant. The separate tables for each species were however used for compiling the enumerations, and the resultant figures were used in calculating the yield. It is therefore necessary, in order to avoid introducing a further error, to use the tables separately for the different species when regulating the yield.

363. *Record of Mean and Minimum Girths of trees in natural deciduous forest.*—As explained above, the minimum diameter of trees was measured with callipers during the enumeration, and it was necessary to correct these to mean diameters. The maximum and minimum diameters of over 1,200 trees (of which 855 were teak) were measured with the following results :—

Teak (from measurements of 855 trees).

Callipered minimum girths.	30″	36″	42″	48	54″	60″	66″	72″	78″	84″	90″	96″	102″
Corresponding mean girths.	31·4″	37·7″	44·4″	51·3″	57·9″	64·6″	71·5″	78·2″	84·9″	91·8″	98·3″	105″	111·5″

Teak is about the average for the other species, the taped girths of which are approximately as follows :—

	PER CENT.		PER CENT.
Terminalia tomentosa ..	0·3 lower.	*Grewia tiliæfolia*	0·4 lower.
Terminalia paniculata ..	0·5 higher.	*Stephegyne parvifolia* ..	0·8 higher.
Xylia xylocarpa	0·4 lower.	*Dalbergia latifolia*	0·8 ,,
Lagerstrœmia lanceolata ..	0·5 higher.	*Albizzia odoratissima* ..	0·2 lower.

364. *Measurements of form factors in Karian Shola.*—In order to compare the volumes of trees enumerated in 1926, where the mid-girths were estimated, with volumes in the check enumeration done in 1930 where callipers were used for measuring the mean diameter at breast height, a number of measurements were made of the mid-girth over bark (done by climbing coolies), the breast-height girths over bark, and the length of merchantable bole of some of the commoner trees in Karian Shola. Form factors for the various species have been deduced from these measurements and are given below :—

	Form factor.	Number of trees measured.		Form factor.	Number of trees measured.
Calophyllum tomentosum ..	·86	45	*Elæodendron glaucum* ..	·88	27
Hopea parviflora	·84	146	*Canarium strictum* ..	·91	31
Mesua ferrea	·87	147	*Bischofia javanica* ..	·91	16
Dysoxylum malabaricum ..	·89	18	*Vitex altissima* ..	·91	113

These form factors represent the ratio of mid-girth over bark to breast-height girth over bark.

CHAPTER VII.—ESTIMATE OF THE CAPITAL VALUE OF THE FOREST.

365. No reliable data are available for calculating the capital value of the forest. The figures for the annual rent paid for the Tekkadi leased forest do not give any basis upon which a calculation can be made, because the rent was fixed arbitrarily without any reference to the value of the forest.

366. It is moreover impossible to deduce a figure from the quantities and value of the produce extracted, and the money put into the forest in capital works of improvement, because the data for past years are both incomplete and inaccurate.

PART II.

Future Management discussed and prescribed.

CHAPTER I.—BASIS OF PROPOSALS.

SECTION 1.—GENERAL OBJECTS OF MANAGEMENT.

367. In the deciduous forest the main object of management is to attain the highest possible continuous annual net return per acre from the forest within the shortest possible time, and having achieved it, to maintain it in perpetuity. Secondary objects are the prevention of erosion and deterioration of the soil, but these will be achieved if the main object of management is kept in view.

368. In the evergreen forests the main object of management is protective so as to conserve some of the original sources of water-supply for the country, and in particular the water-supplies for the settlements at Anaipadi and Top Slip. At the same time our aim is to produce the maximum financial return per acre per annum from timber and other produce, as far as is consistent with the efficient protection of the water-sources, and provided that the evergreen character of the forest is not altered.

SECTION 2.—MEANS OF ATTAINING THE OBJECTS OF MANAGEMENT.

A. Factors which indicate Future Policy.

369. The factors which indicate future policy may be divided into two groups, economic and sylvicultural.

The economic factors are :

(i) That the Mount Stuart forests are situated so as to be within easy reach of the timber markets in the plains.

(ii) That there is a good demand for timber of large sizes in these markets, but that in order to maintain this demand, a regular uninterrupted supply of timber must be forthcoming.

(iii) That the demand for teak timber is greatly in excess of the present annual yield of this species, and that high prices are realized for it, so that it shows a handsome margin of profit.

(iv) That *Dalbergia latifolia* also fetches high prices, though the demand is apparently limited.

(v) That the other saleable species, which constitute the bulk of the natural forest crop, barely show a profit on extraction, with the exception of *Pterocarpus marsupium* which realizes slightly higher prices than the rest, and that the demand for these woods is distinctly limited.

The chief sylvicultural factors are :

(i) That the locality and climate are eminently suitable for the growth of large timber, especially for teak which grows naturally to a large size.

(ii) That the natural forest crop consists at present of a large proportion of bamboos and miscellaneous species which are either unsaleable, or are only saleable at a small margin of profit, while the proportion of teak, *Dalbergia latifolia* and *Pterocarpus marsupium* is small.

(iii) That throughout the deciduous forest the natural regeneration of valuable species is so scanty, and is so liable to be killed off by fires or by other natural agencies such as Lantana, weeds and creepers that it cannot be depended upon, even with a considerable amount of tending and efficient fire protection, to maintain the stock of valuable species in the forest.

(iv) That the extraction of the mature trees of the most valuable species is followed by the inevitable degeneration of the forest, with an increase in the proportion of the useless, and less valuable species.

(v) That improvement fellings, and operations intended to encourage natural regeneration have proved to be, by themselves, insufficient to check this degeneration.

(vi) That teak can be raised successfully by artificial means at a reasonable cost in areas of concentrated regeneration, and also, probably, in gaps in the natural forest.

(vii) That pure plantations of teak suffer from some of the usual disadvantages associated with pure crops, such as epidemic insect attack, probable deterioration of the soil, etc., and that therefore a mixture of species in the regeneration areas is advisable.

(viii) That the two next most valuable species, namely, *Dalbergia latifolia* and *Pterocarpus marsupium,* appear to be sylviculturally good species for a mixture with teak and are also soil improvers, being members of the family *Leguminosæ*.

(ix) That bamboos although saleable at a profit are not such a remunerative crop as is timber because they produce saleable culms for only little more than half their life period, and because considerable damage is caused to the timber crop and to existing regeneration on account of the severe fires consequent upon their periodical gregarious flowering and dying with resultant invasion of the area by dense Lantana and other weeds and creepers.

B. Means of attaining the Objects of Management.

370. The above factors indicate that the deciduous forest should be worked intensively for large timber, so as to realize the maximum economic yield in perpetuity. This involves the regeneration of all areas worked over, combined with a regulation of yield, so as ultimately to restore the correct distribution of the age classes, and to attain the maximum rate of production of the most valuable species. This will be best effected by the conversion of the irregular natural forests to regular crops of teak, *Dalbergia latifolia* and *Pterocarpus marsupium* in mixture wherever the locality is suitable, combined with the improvement of the other areas of natural forest by regeneration of these species in gaps, with the ultimate aim of producing a forest of mixed age classes with the maximum productivity of the most valuable species. In addition, the yields from all other produce such as small timber, poles, spokes and felloes, bamboos, fuel and minor forest products should be utilized to their full economic capacity, and improved as far as is possible without interfering with the main object of timber production.

C. Methods of Treatment to be adopted.

371. All areas definitely suitable for concentrated regeneration will be selected, worked by clear-felling, and regenerated by planting or sowing with teak, *Dalbergia latifolia* and *Pterocarpus marsupium* in mixture, teak being the chief component, so as to raise even-aged crops of these species.

372. In all other workable deciduous forest areas, selection fellings of all mature timber of saleable species will be carried out, and the area regenerated artificially in patches wherever there is a gap in the canopy. This artificial regeneration of gaps is at present in an experimental stage, and if it is found to be impracticable, and if other certain methods of ensuring the regeneration of selection-felled areas are not discovered, timber extraction by selection fellings will have to be stopped, or at any rate restricted to the removal of timber that is in danger of becoming over-mature. The tending of existing regeneration and the encouragement of promising trees of valuable species by means of improvement fellings ought also to be done, as the crop would thus be greatly benefited. They will however have to be left as a future development owing to the present difficulty of obtaining even sufficient labour and supervision for the extended programme of artificial regeneration, fire-protection, and other more essential works, that are being prescribed under this working plan.

373. In Karian Shola, where the main object is to maintain the evergreen character of the forest, very light selection fellings of mature and over-mature timber will be made and regulated in such a way that no large gaps in the canopy are formed. Experimental artificial regeneration of gaps, and the tending of existing regeneration of *Hopea parviflora* will also be prescribed.

374. The felling of bamboos will be permitted without restriction up to the limits of the capacity of the forest.

375. Minor forest produce will be collected departmentally with the two fold purpose of eliminating a cause of fires, and of learning something about this hitherto much-neglected source of revenue. In that portion of the working plan area, however, which is included in the new Ulandi range, the right to collect minor forest produce will continue to be leased out to contractors.

SECTION 3.—PERMANENT DIVISION OF THE AREA.

376. *Blocks.*—The whole working plan area is divided into four blocks, namely,—

(i) The Mount Stuart block, which consists of all the forest east of the Coimbatore-Malabar boundary, and north of the Vengolimalai-Umayamalai ridge ;

(ii) *the Tekkadi Leased Forest* block consisting of the whole of the forest lying to the west of the Coimbatore-Malabar boundary ;

(iii) *the Ulandi block* consisting of the forest lying south of the Umayamalai-Vengolimalai ridge, and north of the Nadumalai-Olaivaraimalai ridge ; and

(iv) *the Palakadavu block* to the south of the Nadumalai ridge, as far as the southern limit of the Tunacadavu range.

377. *Compartments.*—For purposes of management, description, location and record of works, and in order to study the improvement of the forest, the whole area has been divided into permanent compartments by natural features as far as possible, regardless of working circle boundaries. They are numbered in Arabic figures consecutively throughout the four blocks in one series, from 1 to 102. The average area of a compartment in the Mount Stuart and Tekkadi blocks is 281·5 acres. Whereas in the Ulandi and Palakadavu blocks, where the management is not so intensive, the average area of a compartment is 568·8 acres.

SECTION 4.—WORKING CIRCLES, THEIR AREA AND DISTRIBUTION, AND REASONS FOR THEIR FORMATION.

378. Five working circles are prescribed—

(i) *The Clear-felling Working Circle.*—This consists of all the areas already clear-felled and regenerated with teak or other species, together with all the areas in the natural deciduous forest considered to be suitable for planting with teak, within the Mount Stuart and Tekkadi Leased Forest blocks. These areas have been selected during enumeration and marked on the map. The total area of this working circle is 8,689 acres. In addition there will be all the areas which are in the future clear-felled and planted in the Ulandi and Palakadavu blocks. These will form a separate felling series of the Clear-felling Working Circle, which will be known as the Ulandi Felling Series.

(ii) *The Selection Felling Working Circle.*—This consists, in the Mount Stuart and Tekkadi Leased Forest blocks, of all the remainder of the workable, deciduous forest, not considered to be suitable for clear-felling and planting ; and in the Ulandi and Palakadavu blocks of the whole workable forest. The two former blocks form the Mount Stuart Felling Series, and the two latter the Ulandi Felling Series. The total area is 19,760 acres.

There are areas suitable for clear-felling and planting in Ulandi and Palakadavu but they have not been separated off as a part of the Clear-felling Working Circle since it is unlikely that regular clear-felling and regeneration can be done owing to the fact that the exploitation of these blocks is at present dependent upon contractors being found who are ready to work them. When such areas are clear-felled and planted they will form the Ulandi Series of the Clear-felling Working Circle (vide paragraph 584 below).

(iii) *The Karian Shola Working Circle.*—This consists of the block of evergreen forest lying to the north-west of Top Slip. Its area is 2,060 acres. All other portions of evergreen forest within the working plan area are classed as unworkable owing to their inaccessibility.

(iv) *The Bamboo Working Circle.*—This covers the whole of the deciduous forest of the Mount Stuart and Tekkadi Leased Forest blocks, wherever bamboo occurs. The area of the forest covered with bamboo cannot at present be ascertained owing to the fact that over most of the area it has flowered and died within the last few years. The area of this working circle will gradually decrease as the clear-felled areas increase. The bamboo areas in the Ulandi and Palakadavu blocks are not included owing to their inaccessibility.

(v) *Minor Forest Produce Working Circle.*—This working circle covers the whole working plan area.

379. Portions of the forest not included in the first four working circles are classified as unworkable, and consist chiefly of rocky precipitous areas throughout the forest, as well as of the evergreen areas in the Ulandi and Palakadavu blocks.

Period of the Working Plan and necessity for Intermediate Revision.

380. This working plan will remain in force for a period of ten years, from the 1st of April 1931 to the 31st of March 1940. Its revision must be taken up sufficiently in advance of the end of this period to allow of its completion before the 31st of March 1940, so that there will be no break in continuity.

381. Intermediate revision of the regeneration prescriptions in the Clear-felling, Selection Felling and Karian Shola Working Circles, should be made after four years, or as soon after that date as sufficient experience of the various operations has been acquired.

382. Revision of the volume tables should be undertaken as soon as sufficient data for each species has been collected. It must be understood however that the original volume tables given in Appendix F of this plan must be used for regulating the yield until the yield itself has been re-calculated on the basis of the revised volume tables.

CHAPTER II.—WORKING PLAN FOR THE CLEAR-FELLING WORKING CIRCLE.

SECTION 1.—GENERAL CONSTITUTION OF THE CIRCLE AND CHARACTERS OF VEGETATION.

383. *Area.*—The total area of the Clear-felling Working Circle in the Mount Stuart and Tekkadi Leased Forest blocks is 8,689 acres. Of this 1,857 acres have already been converted into plantations, and 6,832 acres remain to be planted.

384. *General constitution.*—This circle consists of all the best localities in the deciduous forest in the Mount Stuart and Tekkadi Leased Forest blocks. During the enumeration survey of the forest every 1½ acre rectangle of the map was assessed by the enumerating foresters as being either ‘ suitable ’, ‘ unsuitable ’ or ‘ doubtfully suitable ’ for planting with teak. A large percentage of the area was checked by the working plan officer, and all doubtful areas were classified as being either probably suitable or probably unsuitable judging from the height growth of the crop and the species enumerated. Each rectangle on the map was then coloured according to suitability, and the most suitable compact blocks were marked out, and assigned to the Clear-felling Working Circle. Some suitable areas will thus have been omitted from the Clear-felling Working Circle, and some small unsuitable areas have unavoidably been included, in the interests of simplicity. All the areas already clear-felled and planted are also included in this working circle.

385. In addition to the above all areas that are clear-felled and planted in the Ulandi and Palakadavu blocks will be included in the Clear-felling Working Circle as they are worked, and will form a separate felling series which will be known as the Ulandi Felling Series.

386. *General characters of the vegetation.*—In Part I, Chapter II, the general types of the vegetation have been described in detail. The Clear-felling Working Circle consists chiefly of sub-type I, which is characterized by good height growth, a limited number of species and large-sized bamboos over most of the area which prevent the natural regeneration of tree species. A small amount of sub-type II may be found, consisting of poorer quality forest with a great variety of species. Lantana is found almost throughout the working circle, and comes up densely in any clearings.

387. As regards the areas already regenerated, some 160 to 200 acres may be considered to have failed owing to the unsuitability of the localities chosen. Most of the remainder is fairly well stocked with teak. In the areas where teak and *Dalbergia latifolia* were grown in alternate strips, the percentage

of success among the latter species is mostly poor. A fuller description of the plantations will be found in Part I, Chapter II, and in the history of the compartments.

SECTION 2.—PERMANENT DIVISION OF THE AREA.

388. *Blocks.*—The Clear-felling Working Circle lies in all four blocks of the working plan area.

389. *Compartments.*—The area is subdivided into permanent compartments, or portions of permanent compartments, the boundaries of which follow natural features and are independent of working circle boundaries.

SECTION 3.—TEMPORARY DIVISION OF THE AREA.

390. For purposes of reference and description, temporary sub-compartments will be formed within each compartment, for areas which are worked under different methods of treatment. They will be labelled *a*, *b*, *c*, etc., and will be marked on the map.

391. The Mount Stuart Felling Series will be divided into four periodic blocks. The clear-felling coupes for the next ten years will be laid out on the maps ; they will be demarcated on the ground as they are worked. To facilitate demarcation, the boundaries of the coupes will coincide with the compartment boundaries as far as possible, and all cut lines will run north-south.

Most of the coupes will be demarcated by a single cut line.

392. Each year's clear-felling coupe will, when regenerated, be subdivided into areas of not more than 25 acres by inspection paths and fire-lines.

393. When any work is done in a compartment, the compartment and sub-compartment boundaries will be cleared unless they follow definite natural features and compartment boards of teak 30 inches by 18 inches, with the compartment numbers chiselled on them at the corners. If possible, they should be securely nailed on to trees well out of the reach of elephants.

394. Clear-felled areas will also be labelled with similar boards giving the date of formation of the plantation.

395. All temporary divisions of the area will be surveyed and marked on the 12-inch scale map, which accompanies the working plan, as they are worked.

SECTION 4.—ANALYSIS AND VALUATION OF THE CROP.

396. A 100 per cent enumeration was carried out over the whole workable area of the forest including the unconverted portion of this working circle. For details of the method employed see Part I, Chapter VI. The numbers of trees and volume of timber of teak, *Dalbergia latifolia* and other saleable species are given below. For details of species separately, and for information regarding the unsaleable species, the volumes of enumeration sheets may be referred to. These may be found in the Mount Stuart Working Plan Record Box in the Working Plan Circle office.

Species.	Breast height girths over bark.			
	3 to 6½ feet.	6½ to 7½ feet.	Over 7½ feet.	Total over 3 feet.
	Volume in cubic feet.	Volume in cubic feet.	Volume in cubic feet.	Volume in cubic feet.
Teak	659,302	404,117	814,858	1,878,277
Dalbergia latifolia	82,156	24,217	41,296	147,669
Other saleable species	2,037,377	577,477	969,849	3,584,703
Total ..	2,778,835	1,005,811	1,826,003	5,610,649

397. No enumerations nor stock maps of the plantations have been made as they are not yet required. The necessity of making them should however be considered at the next revision of the working plan. A list of the various plantations with their respective areas and dates of formation is given below :—

Year of formation.	Area according to district figures.	Area according to 12-inch map.	Remarks.
	ACS.	ACS.	
1916	5	5·00	The external boundaries of these plantations were mapped in the field on 12-inch scale. Internal boundaries were put in from district surveys which were very inaccurate and did not fit each other.
1919	28	25·95	
1920	8	7·02	
1921	29	37·51	
1922	126	105·35	
1923	193	137·96	
1924	226	272·27	
1925	251	236·80	
1926	261	267·20	
1927	155	146·37	Actually mapped on the 12-inch scale.
1928	144	127·53	
1929	151	143·51	
1930	224	241·78	From district surveys.
1931	103	103·00	
Total ..	1,904	1,857·25	Difference 46·75 acres=2·6 per cent

SECTION 5.—METHOD OF TREATMENT.

398. *Exploitable size.*—Timber of saleable species from clear-fellings in the natural forest is usually exploitable down to a girth of about 3 feet over bark at breast height. Some smaller timber is also occasionally saleable locally. The value of logs under approximately 6 feet in girth is less than for larger sizes.

The exploitable size of plantation teak is expected to be between 5 and 6 feet girth at breast height. An average girth of 6 feet is aimed at, and the rotation is calculated accordingly.

399. In periodic blocks II, III, and IV subsidiary fellings down to a girth limit of $7\frac{1}{2}$ feet at breast height will be carried out in order to remove over-mature timber and all timber that might otherwise become over-mature during the first period.

400. *Choice of species.*—Teak will be the primary species in the plantations on account of its greater value, and the ease with which it can be regenerated. Owing to the dangers which are associated with pure crops of trees which do not grow gregariously in their natural state no effort should be spared to obtain a mixture, with *Dalbergia latifolia* and *Pterocarpus marsupium* as the chief auxiliary species. All other woody species coming into the plantations naturally are to be encouraged, and slight damage to the teak on this account may be disregarded, since it will be outweighed by the benefits of a mixture.

401. The question of an underwood must also constantly be borne in mind, and the best species for this purpose, and the cheapest and easiest means of introducing them must be investigated.

402. *Sylvicultural system.*—The sylvicultural system will be clear-felling of the natural forest with concentrated artificial regeneration either by sowing or planting.

403. In the portions of the working circle which are not to be regenerated within the next thirty years, subsidiary fellings of mature timber over a $7\frac{1}{2}$ feet girth limit will be carried out.

404. It would be desirable to regenerate the gaps caused by subsidiary fellings in the last periodic block during the first period, since such regeneration would attain saleable dimensions by the time the area became due for clear-felling. Owing, however, to the great increase of work elsewhere, and to the lack of sufficient labour and supervision, as well as to the fact that the success of gap regeneration in natural forest has not yet been definitely proved, it has been decided not to attempt it. This matter should receive further consideration when the working plan is revised.

405. Improvement fellings in the later periodic blocks are also desirable but are not practicable with the present staff and labour supply. The possibility of doing them should also be considered at the next revision of the working plan.

406. *Calculation of the rotation.*—In the absence of sufficient reliable statistics of the increment of plantations at Mount Stuart, an accurate calculation of the rotation is impossible. An exploitable size of 6-feet girth over bark at breast height is aimed at. A curve compiled by Mr. Wood from ring countings on stumps of natural teak trees, when he was preparing the last working plan indicates that, after correction to breast height (4 feet 6 inches) and allowing for bark thickness, natural teak attains a girth of 5 feet 3 inches in 100 years. Plantation teak is known to grow faster than teak in natural forest, and therefore it has been considered safe to fix the rotation at 100 years. This may be optimistic as measurements made in 'Waterfall' plantation (about the oldest we have in Mount Stuart) seem to indicate that it is approximately the same as a Nilambur third quality plantation, which, in 100 years produces teak with a girth of only 49·1 inches. This plantation however shows signs of neglect throughout its early life, and may be taken to be abnormal. In consideration of the above, the rotation for the Clear-felling Working Circle is fixed at 100 years.

407. *Division into Periods.*—The rotation will be divided into four periods of 25 years each.

408. *Allotment to Periodic Blocks.*—The total area of the Clear-felling Working Circle, including the area already planted up will be divided into four approximately equal periodic blocks, as follows :—

	ACS.
Total area of existing plantations including 1931 regeneration area	1,857
Area of natural forest not yet converted	6,832
Total area of the working circle	8,689
Hence the average area of each periodic block is	2,172

The average annual area to be regenerated is therefore 86·89 acres approximately.

409. The actual area of the first periodic block is 2,176 acres. Of this area 1,857 acres have been planted up in the last twelve years, leaving a balance of 319 acres to be regenerated.

410. In order to adjust the area within the first period the following programme will be carried out :—

Period.	Years of clear-felling.	Years of regeneration.	Average annual area to be regenerated.	Total area regenerated at end of period.
			ACS.	ACS.
Remainder of—				
I	1931 to 1934	1932 to 1935	79·8	2,176
II	1935 to 1960	1936 to 1961	87·0	4,351

411. By this arrangement, the total area will have been regenerated by the year 2,011, and the first plantations made will be only 95 years old. By felling at the regular rate of 86·9 acres a year, the discrepancy in final age will be adjusted. The average ages of the crops felled in the first ten years after conversion is completed will be 90·8, 90, 90·3, 91, 91·5, 92, 93, 93·1, 94 and 95 years respectively. This method of adjusting the irregularity of the areas already regenerated is considered preferable to doing so by fixing the conversion period at 100 years from the date of formation of the first plantation, thereby entailing smaller annual regeneration areas and a postponement of the date of completing conversion.

412. *Felling cycle.*—The felling cycle for the subsidiary fellings in Periodic blocks II, III and IV is not fixed since it is impossible to do so, and at the same time fix the girth limit and the yield. Subsidiary fellings will not be carried out in any areas that are to be clear-felled within 25 years.

413. During the second period, subsidiary fellings will be confined to Periodic Blocks III and IV, and during the third period Periodic Block III will be clear-felled and regenerated, and Periodic Block IV will be worked over for subsidiary felling.

414. There will be no subsidiary fellings in the last regeneration period. The yield from subsidiary fellings will therefore be less in each subsequent period, but this diminishing yield will be more than compensated for by an ever increasing yield from thinnings.

415. *Calculation of the yield.*—The total quantity of timber that will be removed from the Clear-felling Working Circle in one rotation is equal to the whole growing stock plus the increment accruing on the unfelled portion of the same.

416. According to Von Mantels' formula the annual increment on a rotation of 100 years, is 2 per cent of the growing stock. As about a half of the growing stock in the Clear-felling Working Circle is over $6\frac{1}{2}$ feet in girth, the increment is obviously in defect, and so it will be reduced to $1\frac{1}{2}$ per cent per annum. On an average, increment will accrue on only a half of the growing stock. The total quantity to be removed annually during the remaining 79 years of the first rotation will therfore be $\frac{V}{79} + \frac{1}{2}\left(V \times \frac{1\frac{1}{2}}{100}\right)$
where $V =$ present volume of the growing stock. The total growing stock over 3 feet in girth is 5,610,649 cubic feet of timber of saleable species. The annual yield will therefore be $\frac{5,610,649}{79} + \frac{5,610,649}{2} \times \frac{1\frac{1}{2}}{100} = 71,021 + 42,080 = 113,101$, or 113,000 cubic feet.

417. *Regulation of the yield.*—The yield will be obtained partly from clear-fellings and partly from subsidiary fellings. The clear-fellings, which will produce the major portion of the yield, will be regulated by area.

418. Coupes of more or less equal area will be clear-felled each year with the object of securing an even series of age gradations, and ultimately a sustained yield. The outturn from these coupes will vary greatly.

419. The yield from the subsidiary fellings will be regulated by volume. The quantity of timber to be felled each year in the subsidiary fellings will be the total yield prescribed in paragraph 416 minus the outturn from the clear-felling coupe of the year.

420. The areas to be felled by subsidiary fellings during the period of this plan will be marked on the map and the sequence of the fellings will be prescribed. The subsidiary fellings will proceed in regular order through the specified compartments, all saleable timber over $7\frac{1}{2}$ feet in girth being removed, until the required outturn is obtained. In all estimates of the yield from enumerations both in clear-felling and subsidiary felling coupes made for the purpose of regulating the yield, the volumes must be calculated from the provisional volume tables given in Appendix F.

421. There must be no selection of valuable species. The girth limit of the subsidiary fellings has been fixed at $7\frac{1}{2}$ feet at breast height to start with, so as to remove all over-mature timber but leave enough mature timber to prevent a sudden diminution in yield in the third and fourth period.

422. The progress of the subsidiary fellings must be watched to see that they are proceeding at approximately the correct rate. If it appears, at later revisions of the plan, that they will not cover the whole area before the end of the second period, the girth limit may have to be altered accordingly.

SECTION 6.—METHOD OF EXECUTING THE FELLINGS.

423. *Demarcation and Survey of Coupes.*—The annual coupes, which have been marked on the map will be laid out on the ground, demarcated by a cut line and surveyed. Care must be taken that the surveys are accurate, and that sufficient reference is made to topographical features while surveying to enable the plotted boundaries to be correctly placed on the control map. This applies to both the clear-felling coupes and the subsidiary felling coupes.

424. *Marking for felling.*—All trees of exploitable size, in the clear-felling coupe, and all trees of 7½ feet girth and over in the subsidiary felling coupe will be enumerated, and serially numbered in tar at the base of each tree and also on the bole at about 4 feet from the ground. The bark and sapwood must be removed, and the numbers written in such a way that they will remain clearly legible for at least eighteen months. Each year the same series of numbers should be continued throughout all the coupes in the range in all working circles irrespective of species, so that there may be no possibility of confusion. At the same time as numbering, the girth of each tree over bark will be measured at a point 4 feet 6 inches from the ground, the total length of saleable logs contained in the tree will be estimated by eye and the particulars entered in Form 3. Not less than 10 per cent of the marking and measuring shall be checked by the District Forest Officer or a gazetted assistant. It is very important that these measurements be made accurately as they will be required for the compilation of volume outturn tables for standing timber. The cubical contents of each tree will be ascertained from the provisional volume table given in Appendix F, and will be entered in column 5 of Form 3.

425. The marking and enumeration must be finished by July of the year previous to felling and the marking lists and estimate of yield must be prepared in August. In view of the pressure of other works from May onwards, it will probably be advisable to do the survey and demarcation in January, and the marking in February and March. This is not prescribed definitely however, and it is left to the discretion of the District Forest Officer to do the marking when it is most convenient, provided that it is finished without fail before the end of July of the year previous to felling.

426. Marking as described in paragraphs 424 and 425 above must be done for all coupes in all timber working circles, whether they are to be exploited by contractors or worked departmentally. At the time of marking for subsidiary fellings, all creepers and climbers attaching trees to be felled to trees to be left standing will be cut. This will also be done when marking in the Selection and Karian Shola Working Circles.

427. *Extraction plan.*—At the time of marking, a detailed extraction plan of each coupe must be drawn up showing the location of drag paths and cart-tracks on the large-scale map (12 inches = 1 mile). Unnecessary dragging must be avoided, and short cart-tracks should be laid out into the coupes in such a way as to reduce dragging as far as possible.

428. *Felling of saleable species.*—The felling of saleable species will commence as early as possible, and certainly not later than the 15th of June. Trees will be felled with as little wastage as possible. They should be thrown with the crown away from the direction in which they will be extracted, to facilitate the removal of the logs by elephants.

429. *Logging.*—After felling, the trees will be logged at stump site. This operation, which in the past has frequently been left to the felling coolie, is one which requires considerable discretion. The marking of the points for logging must be done by the felling ranger, and his work must be closely watched by the District Forest Officer, as great loss is caused through bad conversion. In general logs should be as long as it is possible to cart them, provided that they are reasonably straight. Whenever possible bends in the middle of a log should be avoided, and cross cutting should be done at the bends. An unsound portion at the end of a log should be cut off if it detracts from the quality of the log, and in cutting off such portions, the utility of the piece cut off for making spokes and felloes should be considered. The aim is to produce good looking logs of as high quality as possible, provided that the loss in volume caused by cutting out the bad portions is more than counterbalanced by the increase in price on the improved quality of the log.

430. The question of the advantage or otherwise of squaring logs must be investigated. Squared logs invariably fetch a higher price than round logs, but sufficient data on such points as the loss in volume by squaring, the extra cost of squaring, the saving in carting, and the increase in price realized have

not yet been collected, to enable it to be stated definitely whether the operation is a profitable one. A certain number of logs must be squared each year, and a record kept of the following points :—

Volume of log before squaring (Vr).
Volume of log after squaring (Vs).
Reduction factor in volume for squaring = (F)—(Vr/Vs).
Cost of squaring per cubic foot of round log (C).
Carting rate per cubic foot to Pollachi (R).
Average price realized for round logs per cubic foot (Pr).
Actual price realized for the squared logs per cubic foot (Ps).

Then the gain or loss by squaring can be determined by the following formula.

Gain or loss per cubic foot of round log $= (Ps \times F) - Pr + R\,(1 - F) - C$.

431. All costs and rates should be expressed in annas or decimals of an anna, and all volumes measured by the quarter-girth method.

432. Notes should also be made regarding the quality of the log before squaring. It will probably be found that it will pay to square some species and not others, or else that logs with certain types of defect may be squared with profit. For the next three years, at least 5 per cent of the logs of each species should be squared and data collected as above, by which time sufficient data should have been collected to ascertain which is the most profitable form in which to put the timber on the market.

433. Logs that are too large to be carted should be squared if there will not be too great a loss in volume. Otherwise they should be sawn longitudinally, care being taken that the cut is made along, or parallel to the worst crack in the log. It usually pays to square drastically in order to avoid longitudinal sawing.

434. The comparative cost of squaring by the axe and of squaring by sawing off the side slabs should also be investigated.

435. *Numbering of logs.*—As soon as a tree is converted, the logs will be numbered according to the present practice. The year of felling, coupe number, species, tree number (which must be the same as the enumeration tar number), and log letter (A, B, C, etc., for the butt, second and third logs respectively) will be chiselled on each log. The portions of longitudinally sawn logs will be given numbers after the log letter.

436. *Dragging to roadside depots.*—The logs will be dragged to the roadside as soon as possible after conversion. As mentioned above, unnecessary dragging must be avoided by making cart-tracks into the felling areas. Depots in the forest and on the roadside should be under the shade of overhanging trees. Logs must be carted to Pollachi and sold as soon after felling as possible so as to avoid degrade through exposure. The importance of the rapid disposal of all timber cannot be overstated.

437. *Spokes and felloes.*—The conversion of spokes and felloes from top ends and waste timber will proceed simultaneously with felling.

438. *Completion of fellings.*—All saleable timber will be extracted from the clear-felling area by the end of September.

439. The felling prescriptions in paragraphs 423 to 437 above apply also to the subsidiary fellings in the later periodic blocks and to fellings in the Selection and Karian Shola Working Circles. The subsidiary fellings need not however be completed before the end of September, and may be done after the clear-fellings and selection fellings, since no regeneration has to be done in subsidiary felling areas.

SECTION 7.—SUBSIDIARY SYLVICULTURAL REGULATIONS IN CLEAR-FELLING AREA—PREPARATION OF THE AREA.

440. *Clearing the area.*—When all saleable timber has been removed from the area, clear-felling of bamboos and useless species will commence. After clear-felling, small logs top ends, bamboos and other residue should as far as

possible be sold in situ to contractors, who will be required to remove all such residue before the 31st of January. Sufficient material shall however be left all over the area to ensure a good burn. In areas where there are no bamboos, all Lantana and undergrowth must be cut, and if chips from the conversion of spokes and felloes are available, they should be scattered in places where there is little else to burn. Clear-felling must be completed by December 15th.

441. In December a fire-line 12 feet wide is to be cut all round the regeneration area, and this will be scraped and burnt at the beginning of February, shortly before the regeneration area is burnt. Sufficient measures will be taken, according to the nature of the locality to prevent fire from escaping out of the area into the surrounding forest during the burn.

442. *Burning the area.*—The area is to be burnt before the end of February. A definite date cannot be fixed, but it is usually found that the felled material is dry enough to burn by about the end of the first week in February, and that it is advisable to burn before the middle of February owing to the risk of showers towards the end of that month. Piling and reburning the material left by the first burn will be carried out during the rest of February and the early part of March. It should be completed by March 15th. The desirability of obtaining a good burn, and as far as possible an even burn over the whole area *in the first instance* cannot be overstated. Piling and reburning are expensive operations, and should be reduced as far as possible. It is not necessary that all large logs be completely consumed, provided that the area is clear enough to carry out the works of regeneration and weeding without hindrance.

443. *Lining and staking.*—The general espacement will be 4½ feet by 4½ feet, except for certain experimental areas detailed below. The lining and staking of the area will be completed by the middle of April, using, in accordance with the present method, a long rattan or rope marked at 4½-foot intervals. In sloping country the lines should run along the contours as far as possible.

444. *Inspection paths.*—Permanent inspection paths will be laid out in the area so as to subdivide it into blocks of not more than 25 acres. These paths will be properly graded, and will be marked with pegs before aligning and staking the area. Existing extraction roads in the area should be used as inspection paths, and the new path should be laid out as far as possible with a view to becoming extraction routes at the time of thinning or final felling. The paths will actually be constructed in the early part of June when the rains have set in and the ground is soft. They will be 6 feet wide and will slope slightly outwards to facilitate drainage. These inspection paths will also serve as interior fire lines, and will be maintained as such when considered necessary by the District Forest Officer.

445. *Interior fire lines.*—When the above are insufficient straight interior fire lines 9 feet wide will be laid out within the regeneration areas as considered necessary for purposes of controlling fires within the plantations and also for subdividing the regeneration areas into workable units. They must be kept clear throughout the fire season.

446. *Observation posts.*—Temporary observation posts, in the form of machans or platforms about 15 feet high will be constructed at suitable points in the regeneration areas. They should be designed so as to serve for the first two or three years of the plantation.

SECTION 8.—SEED COLLECTION AND NURSERY WORKS.

447. *Seed collection.*—It has been shown in Burma that seed from very young trees (i.e., under 25 years old) is frequently of inferior quality. No definite correlation between old age and seed quality has however yet been proved, the chief factor affecting the germinative capacity and the vigour of the resulting seedlings being the size of the seed. It is also known that such defects as twisted grain in trees are frequently hereditary. It is precribed therefore that teak seed will be collected only from straight grained, well-formed trees of over 3 feet in girth at breast height, and that only large seed will be used.

In the case of *Dalbergia latifolia* and *Pterocarpus marsupium* seed collection will be restricted to similar well-formed, straight grained trees of over 3 feet in girth. It is left to the discretion of the District Forest Officers to devise means of ensuring that seed is only collected from suitable trees. It is suggested that, if any trees are found to produce particularly large or good quality seed regularly, such trees should be marked as special trees.

448. The Forest Research Officer has been asked to conduct experiments in the selection of seed trees and the above prescription may require revision if it is found that any definite type, size, age, etc., of tree is definitely superior in the quality of the seed it produces.

449. *Quantity of seed required—Teak.*—The methods by which regeneration of this species will be carried out may be altered from time to time as better methods are discovered. The quantity of seed required must be calculated accordingly. The following data are useful for such calculations :—

Fifty teak seed weigh one ounce.

One bag of teak seed weighs about 60 lbs. and contains about 48,000 seeds.

One nursery bed, 40 feet by 4 feet requires about half a bag of selected seed for broadcast sowing.

One acre of sowing at stake, 12 seeds in each patch at an espacement of 4½ feet by 4½ feet requires a little more than half a bag of selected seed. Twice this quantity should be allowed in order to cover replacements from dumps of germinating seeds.

One bag of seed, as picked, yields about two-thirds of a bag of selected seed.

450. In order to calculate approximately the number of seed trees required, the following example of the areas regenerated by different methods is taken. (This does not infer that the areas and methods given below are prescribed. They are merely given as a basis for calculating the quantity of seed required.)

	Bags of selected seed.
(*a*) For regenerating 45 acres by sowing at stake at an espacement of 4½ feet by 4½ feet allowing for replacements at 100 per cent.	50
(*b*) For regenerating 40 acres by planting stumps 4½ feet by 4½ feet espacement	28
(*c*) Replacements in first and second years at 50 per cent	14
(*d*) For regenerating 50 acres by planting stumps at 6 feet by 6 feet espacement	20
(*e*) Replacements in 50 acres by planting stumps at 50 per cent ..	10
(*f*) For regenerating gaps by stumps in 520 acres of selection fellings	17
Total ..	139

451. Hence 139 bags of selected seed are required. Allowing a margin of 70 per cent for accidents and unfavourable weather conditions, 250 bags of selected, or 375 bags of unselected seed will be required. An average teak seed tree produces 1 to 1½ bags of seed, and therefore about 350 seed trees (in bearing) will be required each year.

452. Teak seed is collected in December and January. Care must be taken that only ripe seed is collected. After collection, the seed will be gone over carefully and all small or undersized seeds picked out and thrown away.

453. Experiments are necessary regarding the best method of treating the seed before sowing. The following method of weathering the seed before sowing is suggested as it is said to give earlier and more certain germination. The seed is spread out evenly on a flat rock, or hard open space and watered occasionally to keep it slightly moist. The seed should be turned over regularly at intervals of about a week and should be left out in the open as long as possible. Watering must not be overdone, or else germination may start in the heaps which is undesirable. Before sowing in the nursery or in the regeneration areas, the seed should be soaked in cold water for 48 to 96 hours. Other methods of seed treatment in order to obtain early and certain germination after sowing should be experimented with.

454. *Dalbergia latifolia.*—The seed is collected in March. Since ripe and unripe fruits occur on the same tree at the same time considerable care is necessary to see that only ripe fruits are collected. A germination test should be done with a sample of seed from each bag collected. One bag of pods (50 Madras measures) is sufficient for 4 acres sown at an espacement of 4½ feet by 4½ feet. An average tree gives 1½ bags of seed in the pod. Hence allowing a margin of 50 per cent for safety, the 57 acres of regeneration area (two-thirds of 85 acres) will require 21 bags of seed. An extra nine bags of seed should be allowed for sowing in the gaps to be regenerated in selection felled areas both in the Mount Stuart Felling Series and the Ulandi Felling Series.

455. *Pterocarpus marsupium.*—Seeds are collected in February and early March. An average seed tree gives about 1 bag of seed which is sufficient for about 1¼ acres of sowing at stake 4½ feet by 4½ feet. Hence for sowing 29 acres of regeneration area (i.e., one-third of 85 acres) about 23 bags will be required. Seven bags should be allowed for sowing in gaps in the Selection Felling Working Circle both in the Mount Stuart and Ulandi Felling Series. Allowing a 50 per cent margin of safety, 45 bags of seed will be required altogether.

456. *Terminalia tomentosa.*—The annual area to be regenerated with this species will be very small, and frequently nil.

457. *Nursery work—selection of sites.*—All nursery sites shall be selected by the District Forest Officer.

458. *Size of nurseries.*—Nurseries will only be required for the production of stumps. A bed 40 feet long by 4 feet broad will produce between 1,400 and 1,800 stumps. For purposes of calculation 1,500 stumps per bed is the figure adopted.

459. The following figures indicate the number of nursery beds (40 feet by 4 feet) that should be allowed per acre for the various methods of regeneration :—

A. Concentrated regeneration 4½ feet by 4½ feet espacement.

	Beds per acre.
Original stump planting	1·43
First-year replacements in stump planted areas at 33 per cent	0·46
Second-year replacements in stump planted areas at 15 per cent.	0·215
First-year replacements in areas sown at stake (from September onwards) at 50 per cent	0·715
Second-year replacements in areas sown at stake at 20 per cent	0·29

B. Concentrated regeneration 6 feet by 6 feet espacement.

Original stump planting	0·81
First-year replacements in stump planted areas at 33 per cent	0·27
Second-year replacements in stump planted areas at 15 per cent.	0·12

C. Gap regeneration in Selection Felling Working Circle.

Allowing for 4 gaps with 25 stumps planted in each per acre, i.e., 100 stumps per acre	1 bed for 15 acres.

460. In calculating the number of nursery beds required for a year's regeneration work, a margin of safety of between 50 and 100 per cent should be allowed in order to provide against unforeseen catastrophes and unfavourable weather conditions. The nursery beds will be separated by paths 1½ feet wide along the sides and 3 feet wide across the ends of the beds. A clear space of at least 6 feet will be allowed all round the beds inside the fence.

461. The following example gives a rough idea of the size of nursery required. If stump planting is done over 40 acres of each year's regeneration area in the Clear Felling Working Circle, and over 50 acres in the Ulandi Felling Series, and if gap regeneration is done in 170 acres of the Mount Stuart Felling Series, and over 350 acres in the Ulandi Felling Series, the size of the nursery required will be (allowing 50 per cent margin of safety) about 300 beds, and will cover an area of 1·8 acres. The number of beds and the size of the nursery must however be worked out each year according to the areas to be regenerated by the various methods, and the quantity of replacements anticipated.

462. *Preparation of the site.*—The selected area will be cleared of all tree growth and undergrowth immediately after the rains, lateral shade being also removed by felling or girdling trees to a distance of 15 yards around the site. Uprootal of tree stumps on the area may be necessary to a certain extent, but the complete removal of all stumps need not be done, as it would constitute an unnecessary expense. The area will be burnt in the following February. The site will then be aligned. A convenient size for the beds is 40 feet by 4 feet, and a pathway at least 1½ feet wide shall be left between the beds, and 3½ feet wide across their ends.

463. During the usual showers which occur towards the end of March and in April the ground where the beds are to be formed will be dug up to a depth of at least 15 inches. Tree roots encountered will be removed, stones thrown away and all clods of earth broken up. This is necessary in order to obtain good plants for stumping with long straight tap-roots. The beds shall then be formed with the surface 6 inches above the ground level, the sides being supported with split bamboos held in position by firmly driven stakes. The depth of worked soil in the beds, after settling, must be at least 18 inches. The nursery will be surrounded by a bamboo fence placed at least 10 feet away from the beds, and provided with a gate. It should be possible to use the same nursery site for three or four years in succession, and by so doing a considerable amount of expenditure in clearing and preparing the area will be saved.

464. *Sowing and tending.*—It is inadvisable to make the prescriptions for sowing too rigid, but until a better method has been established, the following standard method will be followed. Sowing of nurseries will be done during the last fortnight of May. (If it is found that the stumps produced are too big, it may be advisable to postpone sowing for one or even two months, but until this has been definitely proved to be necessary, the prescribed time of sowing will be adhered to.) The seed, whether it has been weathered as suggested in paragraph 453 above or not, will be soaked in cold water for at least 48 hours before sowing. A longer period of soaking may be found to have a beneficial effect on germination. Seeds will be sown broadcast in the nursery beds fairly densely, but not quite touching each other. Half a bag of seed should be sufficient for one bed 40 feet by 4 feet. They will be covered with a thin layer of soil, about one-third of an inch deep. The beds should then be covered with scattered twigs of *Phyllanthus Emblica* (or similar twigs), and finally with a layer of straw. (The twigs prevent the straw being washed down into the soil and facilitate the removal of the straw without damage to the germinating seeds.) The beds will be watered daily on top of the straw. Over-watering should be avoided. The soil should be kept moist and fresh, but should not be wet or puddled. As soon as germination commences, the straw will be removed. Daily watering will be continued, except on rainy days or on days when the beds are obviously moist enough, until the monsoon has set in. Proper watering cans with a good rose should be used.

465. No transplanting of the seedlings into other beds will be done. When the seedlings in a bed become too congested they will be thinned out by pulling out the least well grown seedlings. The final espacement in the beds should be about 3 inches by 3 inches.

466. All nursery beds will be kept absolutely free from weeds and the surface of the soil will be kept well loosened and must not be allowed to become caked. If any attacks of Cockchafer larvæ are noticed in the beds, the grubs must be dug out. In cases where the attack is severe, all sound seedlings should be transplanted to other beds, and the infected bed dug out completely and all larvæ destroyed.

467. Nursery work must be properly organized from the start. The Range Officer is responsible for the nursery, the management of which is one of his chief duties, and he must continually supervise all work done therein, and not merely leave it to the subordinate in charge of the nursery. Every effort should be made to produce vigorous healthy plants from the start. Any delay in weeding, soil working or thinning out, especially early in the first rains, may turn a successful seed bed into a failure.

468. *Stumping.*—When the plants are ready for stumping that is in about 12 months from sowing they will be dug up from the beds progressively from one end to the other, care being taken not to damage them. They should not

be pulled up as the roots are thereby likely to be broken. One to two inches of stem above the collum, and 9 to 12 inches of root will be retained, the remainder being cut off with a sharp knife leaving a clean slanting surface. The edge of the bark should not be loosened from the cambium or torn while cutting. Side roots are to be pruned off close to the tap root. Stumps with twisted, double or malformed roots should be rejected. Stumping should be done immediately on the removal of the plants from the nursery. The operation of preparing the stumps should be carried out in the shade and not in the bright sun, and the stumps having been tied in convenient sized bundles (25 to 50) should be placed in baskets and covered with leaves to prevent dessication. They should be planted out in the regeneration area as soon as possible, and in no case should more than 24 hours elapse between removal from the nursery beds and planting out.

469. The method outlined above (which will be termed the " standard method "), will produce stumps 12 months old which will be about the thickness of a man's finger. In Travancore, seedlings are raised in very densely stocked seed beds, and the resulting stumps are long and thin being not thicker than a pencil. This method (a detailed description of which is given on page 3 of the Chief Conservator's Proceedings No. 321, Press, dated 12th October 1928) has the advantage of reducing the size and cost of the nurseries, and it may be tried experimentally on a small scale. It is doubtful, however, whether the smaller stumps will do so well at Mount Stuart where the rainfall is much less than in Travancore. At Walayar, the stumps are raised by notching germinating seeds direct into the beds at the required espacement. This method claims to be more economical in seed, and saves thinning out the seedlings in the beds. It has the disadvantage however that many of the stumps from such notched germinating seeds have twisted roots. This method should also be tried experimentally on a small scale.

470. *Nursery Costs.*—A rough idea of the anticipated cost of a nursery containing 300 beds, 40 feet by 4 feet, for raising stumps by the standard method is given below :—

	RS.
Clear-felling the area (1·8 acres)	36
Clearing undergrowth and burning	15
Uprooting old tree stumps where necessary	45
Clearing lateral shade	20
Digging to 15 inches depth—300 beds 40 feet by 4 feet. One man can do 105 cubic feet per day (coolies at 12 annas) ..	429
Making up into beds, 60 coolies do 1 acre per day—1·8 acres at 12 annas per coolie	81
Bamboo sides for beds, with stakes	60
Fencing	30
Seed collection 150 bags at Rs. 1–8–0 per bag	225
Sowing and covering with straw—1 coolie does 3,000 square feet per day coolies at 8 annas	8
Purchase of straw	6
Tending seed beds 2 coolies at 8 annas for about 300 days ..	300
Miscellaneous (purchase of tools, gunny bags, etc., and contingencies)	45
Total ..	1,300

Such a nursery would produce about 450,000 stumps, i.e., 346 stumps would cost Re. 1. At this rate the initial cost of stumps for planting up at an espacement of 4½ feet by 4½ feet would be Rs. 6–13–0 per acre of plantation.

471. The above figures are based on untested data (taken chiefly from the Madras Forest Pocket Book), and make no pretensions to accuracy. They may serve however to give a rough indication of the cost of producing stumps. The initial cost of sowing seed at stake including the cost of the seed is about Rs. 4 per acre. It remains to be proved whether the saving in the cost of replacements and weeding by using stumps instead of seeds is sufficient to compensate for the initial difference in the cost of formation.

472. Careful and accurate records of the cost of such separate item of nursery work will be maintained in the Nursery Ledger (vide Appendix D-9). No nurseries are prescribed for *Dalbergia latifolia* or *Pterocarpus marsupium*, since these species will be raised direct by sowing at stake, and no replacement of these species by stump planting is contemplated.

SECTION 9.—FORMATION OF PLANTATIONS.

473. Since the best method of establishing teak plantations has not yet been definitely determined, the following prescriptions must be regarded as provisional. They will be adhered to until it has been definitely proved to the satisfaction of the Conservator that one particular method is better than any of the others prescribed, when a deviation proposal will be submitted for sanction. The position should be reviewed in 1935, and the prescriptions revised, if necessary.

474. Hitherto all teak plantations at Mount Stuart have been raised by sowing seed at stake direct in the regeneration area. The disadvantages of this method, namely the uncertainty of germination, the large percentage of replacements that invariably have to be made, the late germination, the small size of the seedlings at the end of the first season, and the consequent increase in the amount and cost of tending, have already been discussed, and it is possible that other methods of regeneration may prove to be ultimately cheaper and better than direct sowing at stake. The method of planting out teak seedlings from nurseries at the beginning of the rains, which has been the standard practice at Nilambur for many years, does not appear to be suitable for Mount Stuart where the unreliability of the rains is likely to cause many casualties among transplanted seedlings. 'Stumps' (root and shoot cuttings) however are able to stand a considerable amount of unfavourable weather, and the planting of these will probably prove to be a suitable method of regeneration under Mount Stuart conditions. They have the great advantages of being easy to plant, of being more rapid in growth during the first year than either transplanted seedlings or seedlings from direct sowings, and of suffering a comparatively smaller number of casualties. Their disadvantage is that they are more expensive in the first instance, but it is very probable that this extra expense will be more than counterbalanced by savings in the cost of replacements and in weedings, especially in the second year.

475. Another point requiring investigation is that of espacement. Hitherto a 4½ feet by 4½ feet espacement has always been adopted owing partly to the uncertainty of regeneration by dibbling seeds at stake. If stump-planting proves to be a certain method, and if the stumps grow much more quickly than the plants from dibbled seeds, it may be possible to have an espacement of 6 feet by 6 feet. The advantages of the wider espacement are that formation and early weedings are cheaper, and that the first thinning of the plantation can be carried out several years later than in the case of a 4½ feet by 4½ feet espacement. The disadvantage is that the canopy does not close so quickly and hence the cost of the later weedings may be increased. It remains to be proved whether the total cost of establishing a teak crop at an espacement of 6 feet by 6 feet is cheaper or more expensive than at a 4½ feet by 4½ feet espacement. (A possible objection to the wider espacement is that more epicormic branches may be formed, but it has been stated that healthy seedlings do not form epicormic branches if they are growing vigorously, whereas it has certainly been proved that early thinnings tend to produce a crop of epicormics.)

Method of Regeneration to be adopted.

476. *Teak.*—In 1931, teak will be sown at stake at an espacement of 4½ feet by 4½ feet over the whole regeneration area ; since it will be impossible to raise stumps in time. In the 1932, 1933, 1934 and 1935 regeneration areas, teak will be sown at stake in 35 acres at an espacement of 4½ feet by 4½ feet, 30 acres will be planted with stumps at an espacement of 4½ feet by 4½ feet, the rest of the area will be planted with stumps at an espacement of 6 feet by 6 feet. Subsequent to 1935, the area (87 acres) will be regenerated by whichever of the above methods has proved to be the most satisfactory.

477. *Dalbergia latifolia* and *Pterocarpus marsupium* will be introduced by sowing at stake in the same patches as the teak two lines of *Dalbergia latifolia* will be sown, and then one line of *Pterocarpus marsupium*, two more lines of

Dalbergia latifolia and so on. This prescription must be regarded as experimental, and altered if a better method of forming a mixture with these species be discovered.

478. *Stump planting of teak.*—In the areas to be regenerated by stump planting of teak, weed growth will be cut back early in May, and the ground prepared in the showers which occur in that month. Preparation will consist of loosening the soil at each stake by means of a pickaxe or other suitable implement to a depth of 12 inches, and clear weeding to a distance of 18 inches round each stake. Planting should be started as soon as favourable weather occurs. The aim should be to get the planting completed before the first week in June. Experiments have shown that the earlier stumps are planted within reason, the better, and that one or two weeks of dry weather after planting are not harmful. The Forest Research Officer who is studying this matter should be consulted periodically as to the best methods to adopt in stump planting.

479. Until a better method has been established, planting will be done according to the standard practice as described in the Madras Forest Pocket Book. The stumps should be about the thickness of a finger, and should be prepared as described in paragraph 468 above. A hole is made in the middle of the prepared patch with a crowbar or sharpened stick to the exact depth of the stump. The stump is then inserted, and the soil firmly pressed in against the root by thrusting the stick or crowbar in the ground at an angle close to the stump and levelling the soil tight against the root. Damp soil is necessary for easy and successful stump planting. The essential points are—

(*a*) the stump should be planted exactly up to the collum ;

(*b*) the depth of the hole should exactly equal the length of the root ;

(*c*) when driving in the crowbar or stick slantwise and closing the hole, care must be taken that no air spaces are left below or around the root ;

(*d*) the stump must be very firmly planted ; and

(*e*) every stump should be tested before it is left, and only if it is resistant to a fairly hard pull should it be considered as satisfactorily planted.

480. Alternative methods of stump planting are (*a*) notching small stumps direct in wet weather without any previous preparation of the soil apart from clearing weeds, and (*b*) planting in pits, as is done for seedling transplants. Method (*a*) is much cheaper and quicker, and is adopted at Walayar, where it is said to be completely successful. Method (*b*) undoubtedly gives the best results according to experiments, but is more expensive. Experiments should be tried on a small scale at first, to ascertain whether either of these methods is preferable to the standard method. The best size of stumps also requires to be ascertained by experiment.

481. *Introduction of teak by sowing at stake.*—The present practice, which will be adopted until some other method has proved to be better, is as follows. In the latter part of March, the soil will be loosened at each stake in a patch about 1 foot in diameter and 8 inches deep, and 10 to 12 selected teak seeds (see paragraph 452 above) will be planted in the patches and covered with about one-third of an inch of soil. Very close supervision is necessary to see that the coolies put in a sufficient number of seeds at each stake, and that they do not cover them too deeply. Sowing should be completed before the 5th of April.

482. The chief disadvantage of this method is the lateness and irregularity of the germination of the teak seed. Experiments are therefore required to try and discover some means of treating the seed so as to ensure certain and early germination. It is probable that later sowing of seed which has been weathered and kept moist may produce better and earlier germination. The Forest Research Officer should be consulted periodically on the question of seed treatment, of which he is making a special study.

483. *Introduction of Dalbergia latifolia and Pterocarpus marsupium.*—In the first week of June, shortly before the rains, seeds of *Dalbergia latifolia* and *Pterocarpus marsupium* will be dibbled in every patch on the side furthest away from the teak. Two consecutive rows of *Dalbergia latifolia* to one row of *Pterocarpus marsupium* will be sown in this manner. About ten broken pieces of pod of *Dalbergia latifolia* or ten seeds of *Pterocarpus marsupium* will be sown in each patch and lightly covered with soil.

484. *Weeding.*—In view of the present incompleteness of our knowledge regarding the best methods of carrying out weedings, and also on account of the variability of the conditions of weed growth in different seasons, it is neither possible nor desirable to lay down a definite programme of weeding and tending. Past experience has shown that certain principles should be adhered to, and that some operations done at certain times have definitely beneficial effects. The weeding prescriptions will therefore be in the form of suggestions and enunciation of principles, and details of the work are left to the discretion of the District Forest Officer. It is hoped that after a few years of experimental work and careful observation the best methods of carrying out weedings under given conditions will have been discovered and that it will then be possible to draw up more definite prescriptions. The Provincial Sylviculturist must be periodically consulted on this important matter also.

485. *Principles to be observed.*—(*a*) In teak plantations, where browsing is not a factor which has to be considered, the plants must always be kept free of overhanging weed growth, and should always have plenty of light. (*b*) Root competition for moisture with the surrounding weed growth must be eliminated as far as possible. This is especially important in the dry weather, but is not of such importance during the rains. (*c*) When the seedlings are very small, with restricted root systems, the factor of root competition has scarcely commenced to act. Expensive scrapings of soil working at this period are therefore inadvisable. (*d*) Experiments indicate that a mamuti scraping has as good an effect as a deep forking, provided that the scraping penetrates the soil to a depth of about half an inch so as to cut off the weeds below ground level and thus prevent any regrowth. Such a scraping is much cheaper than a deep forking. (*e*) It appears from the latest experiments, that such a scraping done in September very greatly reduces the weed growth during the north-east monsoon, even though heavy rains may fall in October and November. (*f*) A scraping done early in December is reported to be very beneficial. In some experiments done by the Forest Research Officer, the effect of a December scraping was very marked indeed, the teak retaining its leaves and growing vigorously all through the dry weather.

486. The following weeding operations during the first year of the plantation are definitely prescribed. All weed growth will be cut back from the middle of May onwards, care being taken not to disturb the seedlings, stumps or seeds at stake. The area will be gone over sufficiently often to keep the plants completely clear of weeds. All natural growth of woody species, whether from seed or from coppice shoots, will be left during weedings, and may not be cut without the specific orders of the District Forest Officer. It is hoped thereby to induce a mixture of other tree species, and some damage to the teak on this account may be disregarded. As soon as any bamboo regrowth appears in the plantations, it will be cut back right to ground level immediately. It is useless to leave one or two inches of stem when cutting back bamboos, since these stumps sprout again vigorously. The regrowth must be cut flush with the ground. Lantana will be uprooted as soon as it appears in the regeneration area. Cutting back is not sufficient, and when the plants are small they are easy to pull up. The District Forest Officer and the Range Officer must exercise great vigilance to see that bamboos and lantana are dealt with as prescribed above immediately they appear, as neither can be tolerated in a young plantation.

487. The following weeding operations in the first year of the plantation are suggested, but not definitely prescribed. They should, however, be carried out unless some objection is found to them, or until a better practice has been established.

488. A mamuti scraping in lines $1\frac{3}{4}$ feet wide on either side of each line of stakes should be done in September, and another soon after the north-east monsoon has ceased. Early December will probably be the best time for this second scraping, but this will depend upon the season. In steep country, the lines should follow the contours so as to minimize erosion. As an experimental measure a soil aeration by digging or forking to a depth of three or four inches in a patch of 1 foot in radius round each seedling may be carried out in the course of the second scraping over part of the area. Another scraping in

February unaccompanied by aeration, should be tried as an experiment in a portion of the first two plantations formed under this plan. Other experimental measures may be tried by the District Forest Officer when the conditions of weather and weed growth seem to justify them.

489. *Second year tending.*—During the second year it is prescribed that all weed growth interfering with or over-topping the seedlings will be cut back. During these weedings, double leaders and large persistent side branches on the teak plants will be pruned back flush with main stem with a sharp knife so as not to leave ragged edges to the bark. (Small side branches need not be pruned, as they will be suppressed and will fall off naturally later on.) All damaged plants will be cut back to ground level. All lantana will be uprooted, and bamboo regrowth cut back as in the first year.

490. During the third year of the plantation, all that should be required is to keep the heads of backward plants free, to clear creepers, and to cut back any bamboo regrowth. Plants damaged by elephants or insect attack should be coppiced.

491. In all experimental weeding operations, scrapings, soil aerations, etc., the District Forest Officer will keep a record in the control journal of the average outturn of work per coolie, with notes on the condition of the weed growth and the effects of each operation, so that an estimate of the cost and efficiency of different methods of weeding on a large scale may be arrived at. The position will be reviewed in 1934, and as far as is possible, definite weeding prescriptions will then be drawn up in the light of the experience acquired. The only criterion by which the merits of different methods of regeneration and weeding can be judged is that of the total ultimate cost of formation. In general, it may be safely stated that extra expenditure incurred in order to obtain full stocking and the maximum rate of growth in the first year is more than counterbalanced by the saving in the cost of weeding and tending in the second and subsequent years. It cannot therefore be too strongly emphasized that the aim must be to obtain full stocking (not less than 85 per cent in areas of 4½ feet by 4½ feet espacement and 95 per cent in areas of 6 feet by 6 feet espacement), by the end of the first year, and that the maximum rate of growth must be maintained as far as possible throughout the first year.

492. *Replacement of casualties.*—In areas sown at stake, casualties will be replaced during weedings, between 15th July and 15th September, by transplanting surplus seedlings from one patch to another. This applies to *Dalbergia latifolia* and *Pterocarpus marsupium* as well as to teak, the aim being to have at least one teak seedling and one seedling of either *Dalbergia latifolia* or *Pterocarpus marsupium* in each patch. If there are insufficient seedlings for this purpose, further teak replacements should be done with stumps. After September 15th, all replacements of teak casualties will be done by planting stumps, and no further replacement of *Dalbergia latifolia* and *Pterocarpus marsupium* will be done.

493. In stump-planted areas all teak replacements will be made by planting stumps. This will be done immediately after each weeding, or if the weather is then unsuitable (e.g., so dry that the soil is not damp enough for planting) as soon as the weather permits.

494. All second-year replacements of teak will be made with stumps as early as possible during the monsoon. Single replacements between established plants should not be done, since they will never overtake them. Second-year replacements should therefore be confined to places where there has been a group of failures. It is not necessary in the second year to replace teak at stakes where there is an established seedling of either *Pterocarpus marsupium or Dalbergia latifolia*. If the work has been done thoroughly in the first year, the amount of replacement required in the second year should be very small.

495. *Cleanings.*—After the end of the second year, cleanings will be done as considered necessary by the District Forest Officer. They will consist of creeper cutting, removal of bamboos and harvesting dead trees. It may occasionally be necessary to cut out trees of *Grewia titiaefolia* and *Lagerstroemia lanceolata* if they are doing serious damage by suppressing the surrounding trees with their spreading crowns. The crowns will have to be lopped before felling. Experiments should however be tried in pollarding them, so as to retain them in the

crop and at the same time prevent them from damaging the surrounding trees of more valuable species. A cleaning accompanied by creeper cutting should always be carried out about two months before thinning so that the officer marking the thinning can at the same time, inspect the cleaning, and also so as to prevent the trees felled in thinning from breaking off the tops of neighbouring trees to which they may be attached by creepers. Any branches of trees infected with *Loranthus* should be cut off and steps taken to see that the parasite does not produce ripe seed after removal, which might be disseminated to other trees.

496. *Regulation of the mixture.*—The District Forest Officer should watch the progress of the *Dalbergia latifolia* and *Pterocarpus marsupium* which has been introduced along with the teak, and if at any time these species appear to be in danger of suppression, he should order such operations as he considers necessary in order to keep them alive. It is not necessary to do much more than keep them alive until the time of the first thinning, when the letting in of light should provide sufficient stimulus to induce these species to go ahead. The aim should be to produce a final crop in which the mixture is about 60 per cent teak, 20 per cent *Dalbergia latifolia* and 15 per cent *Pterocarpus marsupium*, and 5 per cent incidental species.

497. *Thinnings.*—Plantations will be inspected by the District Forest Officer at regular intervals (as laid down in the tabular statement in paragraph 524 below), to see if they require thinnings. It is expected that thinnings will be required in about the sixth, twelfth, eighteenth, thirtieth and fiftieth years after formation. In deciding whether a plantation requires thinning or not, the state of the whole plantation must be considered, as it is impossible to carry out piecemeal thinnings in a portion of the area one year, and in other portions in subsequent years.

498. Marking for thinning will be done by the District Forest Officer, a gazetted assistant, or by a specially trained ranger. At least 15 per cent of the marking should be done by the District Forest Officer himself at which time he can instruct his assistants or rangers in the degree of thinning required. Until a marking officer is thoroughly acquainted with the result of his markings, felling should be done at the same time so that he can judge the effect and correct any errors on the spot. Marking will be done with a ' risser, ' on both sides of each tree.

499. The degree of thinning required depends entirely upon the state of the wood thinned. The general principle to be observed is that the thinnings should be as heavy as possible provided that no lasting break in the leaf canopy is made. Early thinnings therefore should be heavier than later thinnings since young trees respond to opening out more quickly than older trees. As a general rule, in average localities, the thinning should be ' C grade ' (see Madras Forest Pocket Book, page 110). The trees left behind should as far as possible be healthy well-formed dominant trees, and they should be as evenly spaced as possible. All dead, dying, suppressed, dominated and badly formed or diseased dominant teak trees should be removed. The reason for removing suppressed teak trees is that by so doing, more light is let in which will assist the growth of the *Dalbergia latifolia* and *Pterocarpus marsupium*. The development of trees of *Dalbergia latifolia*, *Pterocarpus marsupium* and other useful species should be encouraged, and the marking officer must continually bear in mind the need for the preservation of a mixture, with teak as the principal species in the final crop and *Dalbergia latifolia* and *Pterocarpus marsupium* as the main auxiliary species. Other trees species coming in naturally should be favoured in the thinnings as far as possible, though if they are likely to do serious damage to the surrounding growth of more valuable species by suppressing them, they should be pollarded at such a height that the new crown will be developed below the upper canopy and will help to cover the ground. If pollarding proves to be unsuccessful such trees should be felled and removed, but it will be necessary to lop the crowns before felling.

500. The number of trees to be removed in a thinning will be counted before felling, and checked when the poles are dragged to the roadside.

501. *Exclusion of cattle.*—No grazing will be allowed in any of the plantations, and cattle must not be allowed to enter them.

502. *Underwoods.*—No definite prescriptions for the introduction of underwoods can be made, since a successful method of doing so which is not prohibitively expensive has not yet been discovered. The question of underwoods is sylviculturally of considerable importance in pure teak plantations and must not be lost sight of. Experiments should be undertaken in order to discover the best species for this purpose and the most successful and least expensive methods of introducing them. It is possible that the natural underwood which develops in most plantations will prove the best solution of this difficulty and it must be encouraged as far as possible. The Forest Research Officer should be consulted periodically on this point.

503. *Cost of concentrated regeneration.*—The following statement shows the approximate cost of formation of plantations by dibbling seeds at stake, and weeding according to the methods adopted hitherto. It is hoped that as experience is gained from the experiments prescribed and suggested in this plan, cheaper and more efficient methods of establishing plantations will be discovered.

Operation.	Cost per acre.								
	Minimum in previous plantations.			Maximum in previous plantations.			Average cost for previous plantations.		
	RS.	A.	P.	RS.	A.	P.	RS.	A.	P.
Clear-felling	5	9	0	20	15	0	16	14	0
Burning (including reburning)	3	3	0	18	12	0	8	2	1
Seed collection and nursery expenses	0	4	0	3	11	3	1	14	0
Aligning, stacking and dibbling, ...	1	10	0	7	0	0	3	13	5
Weeding, soil working, replacing casualties and tending until established ; (usually considered to be established at end of second year).	10	9	1	36	6	0	25	4	10
Total cost of formation ..	21	3	1	86	12	3	56	0	4

SECTION 10.—MISCELLANEOUS REGULATIONS.

504. *Experiments.*—Various experiments have been suggested or prescribed in the previous sections. They are summarized below :—

(*a*) Experiments to test the advantage or otherwise of squaring logs (paragraph 430).

(*b*) Nursery experiments in different methods of raising stumps (paragraph 469).

(*c*) Experiments to test whether sowing at stake or stump planting by the standard method ; or stump planting in prepared pits is the better method of artificially regenerating teak under the conditions obtaining at Mount Stuart (paragraph 480).

(*d*) Experimental stump planting at 6 feet by 6 feet espacement in order to test whether a successful plantation can be raised at this espacement more cheaply than at the usual 4½ feet by 4½ feet espacement (paragraph 475).

(*e*) Experiments in seed treatment and the date of sowing teak seed in order to obtain early and more certain germination (paragraph 453).

(*f*) Experiments in different methods of weeding (e.g., scraping with mamuties and soil aeration with forks), in order to discover the best times to do these operations, and to compare the results and costs on a large scale with areas in which these operations have not been carried out (paragraph 491).

505. All experiments done on a large scale in order to ascertain costs will have to be carried out by the District staff. Small-scale experiments may either be done by the District staff or by the Forest Research Officer, but if the Research Officer is unable to carry out any of the experiments suggested, then they must be done by the district. The District Forest Officer must keep

in touch with the Research Officer in order to avoid unnecessary reduplication of experiments, and should consult him regarding information already obtained and the results of recent work so as to guide him in designing new experiments.

506. A proper record of all experimental work must be kept, and the Research Officer's advice should be sought on this point. Too much stress cannot be laid on the necessity for adequate control of all experiments, and great care must be taken to ensure that control areas are exactly similar to the areas in which the experiments are being done so that accurate comparisons may be made. The instructions for the conduct of field experiments laid down in the " Experimental Manual " (issued by the Forest Research Institute, Dehra Dun) should be closely followed. The results of experiments must all be communicated to the Forest Research Officer as soon as obtained.

Fire-protection of Plantations.

507. All blocks of plantations will be protected by an external line fifty feet wide where they adjoin natural forest. These lines must be clear-felled and will be burnt over at the beginning of February each year. They will be kept clear of growth and fallen leaves all through the fire season, until the beginning of the rains.

508. The boundaries between contiguous regeneration areas will be maintained as internal fire-lines, 20 feet wide. If any one plantation exceeds 100 acres in extent, it will be subdivided by an internal fire-line 20 feet broad located so as to be in the best position for controlling any fire that may enter the plantations. All internal and external fire-lines will be kept clear of growth, grass and fallen leaves throughout the fire season, i.e., from the beginning of February until the rains commence in June.

509. *Maintenance of inspection paths.*—In the plantations formed previous to 1930, the existing inspection paths are inadequate and further inspection paths will be made after laying out internal fire-lines as prescribed above, so as to divide the plantation into blocks of not more than 25 acres each. They will be 6 feet wide, and when on a slope they will be properly graded and cut out, partly from the solid and partly made up, with a slight outward slope to facilitate drainage. It will be necessary to fell a certain number of poles when making these paths, and such poles will be extracted and sold. Two of the old plantations will be dealt with each year, as prescribed in the tabular statement of operations (paragraph 525).

510. Existing inspection paths in the old plantations, will, if considered suitable by the District Forest Officer also be cut to a width of 6 feet as prescribed above.

511. All inspection paths will be cleared each year, and kept clear. Their positions will be marked on the 12-inch map.

Maintenance of Plantation and Compartment Boards.

512. Coupe and compartment boards will be fixed as prescribed in paragraphs 394 and 393 above. The boards will be of teak 30 inches by 18 inches in size and 1 inch thick, and the numbers will be chiselled. The boards will then be painted white and the numbers picked out in black. They will be fixed on trees out of elephant reach whenever possible. The compartment numbers will be in arabic numerals, and the plantation boards will be marked with the letters R.A. to represent Regeneration Area and the year of formation underneath.

SECTION 11.—CONTROL.

513. *General.*—The following control records are to be maintained separately for the Clear-felling Working Circle :—

(*a*) The Control Book.
(*b*) The Record of Works.
(*c*) The Nursery Ledger.
(*d*) The Regeneration Ledger.

Sample forms of these will be found in Appendix D.

514. The Compartment History, Control Map, and Fire Map which have been prescribed for the whole forest will also have to be maintained, and all information pertaining to the Clear-felling Working Circle posted therein.

515. *The Control Book.*—The felling of coupes to be regenerated will be controlled in the Control Book, which will compare the actual exploitation carried out each year with the prescriptions of the working plan. Fellings of timber, exploitation of bamboos and all exploitation works, as distinct from fellings connected with regeneration works, fire-protection, etc., will be entered in this form. The following, for instance, will *not* be entered in the Control Book ; yield from clear-fellings after all saleable timber has been extracted, thinnings, fellings for fire-lines or inspection paths in plantations, etc. The revenue from these will be credited to regeneration, and the yield from such fellings will be noted in the Record of Works.

516. *The Record of Works.*—All works other than those coming under the heading of " exploitation " will be controlled in the Record of Works. It will compare the execution of all works, other than exploitation, with the prescriptions of the working plan. The costs of all works, except those which will be recorded in the Regeneration Ledger or the Nursery Ledger, will be recorded in the Record of Works. Works carried out, though not prescribed, will also be noted in the Record of Works.

517. *The Nursery Ledger.*—This is not a " control record " in the strict sense of this word, but is a record in detail of the cost of nursery work.

518. *The Regeneration Ledger.*—Like the Nursery Ledger, this is not strictly speaking a control record. It provides for a record being kept for each plantation separately of the cost of every detail of work done therein under standardized headings, and will be maintained until the plantation in question is established. The incidental revenue from thinnings and other sources except clear-fellings will not be recorded in the Regeneration Ledger but will find place in the Record of Works. Sections of each regeneration area which are treated by different methods will be allotted separate pages in the Regeneration Ledger, and separate costs will be recorded for them.

519. *Compartment History.*—The purpose of the Compartment History is to maintain a record for each compartment of all changes which take place within it so that it may be possible to judge whether the forest is improving or deteriorating under the various methods of treatment applied. Whenever any work is done in a compartment the area worked and the yield of timber and other produce obtained will be recorded in the compartment history. Sub-compartments will be formed for areas treated under different systems. The operations carried out under the clear-felling working circle will all be recorded under one sub-compartment, and when the whole area of that working circle within one compartment has been worked, the total area of the sub-compartment will be ascertained and entered in the Compartment History. In addition to operations carried out, any definite sylvicultural changes or occurrences which have a direct influence on the condition of the crop will be recorded (e.g., severe fires, bamboo flowering, etc.).

520. *Maps.*—The Control-Map will be maintained for all working circles on a blank copy of the 12-inch scale map. The coupes clear-felled and regenerated each year will be surveyed and marked on the map, and the year of formation entered. All plantations will be coloured *dark red* and will be demarcated by a *darker red* line inside the thin black boundary line. When the first thinning is carried out, the area will be hatched with *thin black* vertical lines one inch apart. The second thinning will be indicated by another set of vertical lines drawn $\frac{1}{8}$ inch from the first set. The third thinning will be similarly represented by a third set of lines. The fourth, fifth, and sixth thinnings will be represented by one, two and three sets of horizontal lines drawn at the same espacement.

521. All permanent sample plots will be entered on the map, and areas in which any experimental measures are carried out, should be marked.

522. For regulations regarding the maintenance of fire maps and road construction maps, see Chapter 7, paragraph 741.

Section 12.—Tabular Statement of Operations.

523.—*Tabular statement of fellings.*

Clear felling working circle.

Clear-fellings.									Subsidiary fellings.					
Period and coupe number.	Year of Felling.	Year of planting.	Compartment and sub-compartment.	Area in acres.	Estimated outturn in cubic feet.				Compartment.	Estimated outturn in cubic feet.				Total estimated outturn.
					Teak.	Rose-wood.	Other saleable species.	Total.		Teak.	Rose-wood.	Other saleable species.	Total.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
First period—														
I	1931	1932	74 *a* ..	81·00	33,300	2,400	29,200	64,900	29 and 26 (part)	23,650	1,240	23,210	48,100	113,000
II	1932	1933	53 *a* (part), 75 *a*	78·50	43,300	1,200	29,800	74,300	26 and 25 (part)	19,950	870	17,880	38,700	113,000
III	1933	1934	53 *a* (part) .. 52 *a* .. 40 *a* (part) ..	16·44 23·64 39·62										
				79·70	37,000	1,600	26,700	65,300	25 (part), 24 (part) ..	18,660	450	28,590	47,700	113,000
IV	1934	1935	40 *a* (part) ..	79·80	17,800	1,500	25,400	44,700	24 (part), 22 (part) ..	29,770	1,660	36,870	68,300	113,000
Second period—														
V	1935	1936	37 *b* (part).	87·00	30,800	8,600	33,300	72,700	1, 2, 6 and 7 (part) ..	13,260	1,040	26,000	40,300	113,000
VI	1936	1937	40 *a* (,,). 39 *a* (,,).	68·86 18·14										
				87·00	22,500	1,750	32,750	57,000	7 (part), 8 and 9 (part) ..	8,600	1,800	45,600	56,000	113,000
VII	1937	1938	37 *a* (,,). 37 *b* (,,).	40·24 46·76										
				87·00	33,470	9,370	36,160	79,000	9 (part) and 10 (part) ..	5,000	500	28,500	34,000	113,000
VIII	1938	1939	39 *a* (,,).	87·00	41,200	1,800	31,200	74,200	10 (part), 11 and 12 (part).	9,900	330	28,770	39,000	113,000
IX	1939	1940	39 *a* (,,).	87·00	32,000	1,700	38,900	72,600	12 (part), 16 (part) and 18 (part).	18,800	450	21,150	40,400	113,000
X	1940	1941	37 *a* (,,). 36 *b* (,,). 39 *a* (,,).	18·43 48·28 20·29										
				87·00	25,800	2,150	43,700	71,650	18 (part)	20,900	650	19,800	41,350	113,000

Note.—(1) The detailed estimates of outturn from the fellings are approximate only. The quantity of timber removed annually in the subsidiary fellings will be the difference between 113,000 cubic feet and the yield obtained from the clear-fellings, as calculated by the volume tables in Appendix F which were used in fixing the yield in paragraph 416.

(2) The subsidiary fellings will proceed in regular order through the specified compartments, all saleable timber over 7½ feet in girth being removed, until the required outturn is obtained. There must be no selection of valuable species.

524.—*Tabular statement of thinnings.*

Year.	Number of thinning.	Plantations to be thinned.			
		Compartment and sub-compartment.	Year of formation.	Area in acres.	Total area to be thinned.
1931	First	29 *e* and 43 *b* (part)	1925	236·80	..
	Second	39 *c* (part)	1919	25·95	262·75
1932	First	41 *f*, 44 and 45 *J* & *k*	1926	267·20	..
	Second	39 *c* (part)	1920	7·02	274·22
1933	First	61 *d* and 62 *d*	1927	146·37	..
	Second	39 *c* (part)	1921	37·51	183·88
1934	First	64 *b*, 65 *d*, 66 *f* & *g*, 68 *f*, 69 *b* and 70 *b*.	1928	127·55	..
	Second	38 *e* and 39 *c* (part)	1922	105·35	..
	Third	48 *b*	1916	5·00	237·90
1935	First	69 *c*, 71 *b* and 72	1929	143·51	..
	Second	42 *c*	1923	137·96	281·47
1936	First	53 *e*, 72 *d*, 73 *b* & *c* and 75 *c*.	1930	241·78	..
	Second	43	1924	272·27	514·05
1937	First	40 *c* and 53 *d*	1931	102·90	..
	Second	29 and 43 *b* (part)	1925	236·80	..
	Third	39 *c* (part)	1919	25·95	365·65
1938	First	74 *d*	1932	81·00	..
	Second	41 *f*, 44 and 45 *j* & *k*	1926	267·20	..
	Third	39 *c* (part)	1920	7·02	355·22
1939	First	53 *a* (part)	1933	78·50	..
	Second	61 *d* and 62 *d*	1927	146·37	..
	Third	39 *c* (part)	1921	37·51	262·38
1940	First	52 *a*, 53 *a* (part) and 40 *a* (part).	1934	79·70	..
	Second	64 *b*, 65 *d* and 66 *f* & *g*	1928	127·55	..
	Third	68 *f*, 69 *b*, 70 *b*, 38 *e* and 39 *c* (part).	1922	105·35	312·60

(1) Plantations will be thinned in the sixth, twelfth, eighteenth, thirtieth and fiftieth years.
(2) The average area to be thinned annually during the period of the working plan is 305 acres.
(3) The plantations will be inspected to see if they require thinning in the year before the thinning is actually prescribed.

525.—*Tabular statement showing programme for construction of inspection Paths in plantations.*

Year of construction. (1)	Plantation in which paths are to be constructed.		Total area. (4)
	Year. (2)	Area. (3)	
		ACS.	ACS.
1931	1921	37·51	
	1930	241·78	279·29
1932	1922	105·35	
	1929	143·51	248·86
1933	1923	137·96	
	1928	127·55	265·51
1934	1924	272·27	
	1927	146·37	418·64
1935	1925	236·80	
	1926	267·20	504·00

CHAPTER III—WORKING PLAN FOR THE SELECTION FELLING WORKING CIRCLE.

SECTION 1.—GENERAL CONSTITUTION OF THE CIRCLE AND CHARACTER OF THE VEGETATION.

526. *Area.*—The total area of the Selection Felling Working Circle is 19,760 acres.

527. *General constitution.*—The circle consists of all the deciduous forest which is not included in the Clear-felling Working Circle. It includes all the workable deciduous forest of the Ulandi and Palakadavu blocks, as well as the areas of deciduous forest outside the Clear-felling Working Circle in the Mount Stuart and Tekkadi Leased Forest blocks.

528. *General character of the vegetation.*—The general types of the vegetation have been described in detail in Part I, Chapter II. The Selection Felling Working Circle consists chiefly of sub-type 2, which is characterized by moderate height growth, a great variety of species, and other indications of poor quality of locality. The proportion of bamboos in this sub-type is less than in the good quality areas. Some small areas of sub-type I are found in this Working circle, and all the swampy and rocky areas within the limits of workable timber are included.

SECTION 2.—PERMANENT DIVISION OF THE AREA.

529. *Blocks.*—The Selection Felling Working Circle lies in all of the four permanent blocks of the Mount Stuart forests, namely, the Mount Stuart block, the Tekkadi Leased Forest block, The Ulandi block and the Palakadavu block.

530. *Compartments.*—The area is subdivided into permanent compartments, the boundaries of which follow natural features, and are independent of the working circle boundaries.

SECTION 3.—TEMPORARY DIVISION OF THE AREA.

531. *Sub-compartments.*—Temporary sub-compartments will be formed within the main compartments for areas worked under different systems. The sub-compartments will be labelled *a*, *b*, *c*, etc., and will be formed and marked on the map after the areas have been worked.

532. *Felling Series.*—The whole working circle will be divided into two felling series, namely, the Mount Stuart Felling Series, which includes all of the working circle lying within the Mount Stuart and Tekkadi Leased Forest blocks, comprising 7,246·23 acres and the Ulandi Felling Series, consisting of the Ulandi and Palakadavu blocks with an area of 12,513·6 acres.

533. The forests in these two felling series are similar, and the general method of treatment and regeneration will be the same. They are separated on account of the conditions governing exploitation which are different in each case.

534. The Mount Stuart Felling Series is large enough to produce a workable regular annual yield. It is conveniently situated for exploitation and is suitable for intensive departmental working.

535. The Ulandi Felling Series, owing to its inaccessibility, has not been worked reguarly in the past and the total present growing stock, which consists of patches of magnificent timber scattered over large areas of bamboo and inferior forest is insufficient to allow of economic working for more than about ten years if approximately 75,000 cubic feet of timber is taken out annually. In some years more than this and in some years less may be extracted, the object being to exploit the mature and overmature forest as quickly as possible and stock the ground fully with valuable timber so that a regular sustained yield may be ensured for the future. It has been clearly established by careful calculation of costs that under present conditions and with timber prices at

their present level it would not be profitable to construct a road into Ulandi over the Anagundi Pass in order to bring the timber out via Top Slip to Pollachi. But when the object of management referred to above, namely, the establishment of a normal crop of good timber, has been attained, the construction of such a road will be advisable and economical. The only road by which the forest can in its present state be exploited at a profit is via the Cochin Tramway to Chalagudi and the Cochin timber markets. This tramway has however been on the point of closing down for several years past and although the writer was informed by the Diwan of Cochin that it had been given a further lease of life for five years from 1930, nevertheless the possibility of working timber out via Cochin cannot be regarded as certain to continue in perpetuity. The best method of working this forest is through the agency of contractors, and such are now forthcoming who are willing to undertake the work and pay a reasonable price for the privilege of doing so. Under the above circumstances the policy for this felling series must be to extract as much of the mature timber as possible whenever the opportunity occurs through the agency of contractors, and to safeguard the forest by fixing the girth limit for exploitation, and the felling cycle within which no area may be worked over more than once. Such regeneration measures must also be undertaken as will ensure that the forest be left in the improved condition desired. Prescriptions to this effect are included below.

536. Areas in the Ulandi Felling Series of the Selection Felling Working Circle which are clear-felled under the scheme detailed in paragraph 594 below will be transferred to the " Ulandi Felling Series " of the Clear-felling Working Circle.

SECTION 4.—ANALYSIS AND VALUATION OF THE CROP.

537. *A. Mount Stuart Felling Series.*—A 100 per cent enumeration of the crop has been carried out over the whole of this felling series, and the following statement shows the present stocking of the forest :—

Species.	Breast-height girth classes.			Total.
	3 feet to 6½ feet. Volume in cubic feet.	6½ feet to 7½ feet. Volume in cubic feet.	7½ feet and over. Volume in cubic feet.	Volume in cubic feet.
Teak	362,437	138,411	240,204	741,052
Rosewood	73,386	22,657	33,385	129,428
Other saleable species	1,400,176	327,177	514,144	2,241,497
Total ..	1,835,999	488,245	787,733	3,111,977

538. It will be noticed that there is a great deficiency in the numbers of trees in the lower girth classes. There is a certain amount of overmature timber, but it cannot be said that there is an excess in the older age classes. The forest is, as a whole, greatly understocked, and this is particularly noticeable in the deficiency of the smaller girth classes, and has been caused by the system of removing mature timber of valuable species without taking adequate steps to secure regeneration of them in the past.

539. *Ulandi Felling Series.*—A 100 per cent enumeration was carried out over the Ulandi block, but the Palakadavu block, which was added too late for such treatment was roughly stock mapped, and the quantity of timber was estimated from enumeration of sample strips covering 17·2 per cent of the area. A feature of the Palakadavu valley is the occurrence of several small

isolated patches of magnificent teak. The following statement shows the stocking of this felling series :—

Species.	Breast-height girth classes.			Total.
	3 feet to 6½ feet. Volume in cubic feet.	6½ feet to 7½ feet. Volume in cubic feet.	7½ feet and over. Volume in cubic feet.	Volume in cubic feet.
Ulandi.				
Teak	80,461	48,817	175,031	304,309
Rosewood	23,549	12,816	76,187	112,552
Other saleable species	714,590	276,826	622,033	1,613,449
Total ..	818,600	338,459	873,251	2,030,310
Palakadavu.				
Teak	45,328	26,478	213,635	285,441
Rosewood	25,695	16,709	82,449	124,853
Other saleable species	317,847	232,376	637,704	1,187,927
Total ..	388,870	275,563	933,788	1,598,221

540. *Suitability for planting with teak.*—Of the total area of 12,513·6 acres in both Ulandi and Palakadavu blocks 2,925·6 acres are considered to be suitable for clear-felling and planting with teak.

SECTION 5.—MOUNT STUART FELLING SERIES—METHOD OF TREATMENT.

541. *Exploitable size.*—In the absence of any statistics to show the correct financial rotation, it is impossible to calculate the exploitable size. It is fixed arbitrarily at 6½ feet girth over bark at breast height, since timber of this size does not increase in value if left to grow larger, and there is a tendency for it to become unsound. The girth limit for felling has however to be fixed higher than this for the earlier-felling cycles of the rotation owing to the abnormal distribution of the girth classes (vide paragraph 553 below).

542. *Choice of species.*—All saleable species will be extracted over the prescribed girth limit. For regeneration purposes, teak will be the primary species, and *Dalbergia latifolia* and *Pterocarpus marsupium* will be introduced as secondary species.

543. *Sylvicultural system.*—The sylvicultural system will be selection felling of all saleable trees over the prescribed girth limit followed by artificial regeneration of the resulting gaps. It is necessary to regenerate the gaps artificially since all efforts to obtain natural regeneration have in the past failed completely. If the artificial regeneration of gaps also proves to be a failure, selection fellings should be stopped, or at any rate restricted to the removal of timber that is likely to become overmature or to die naturally within a few years. No exploitation without certain regeneration is a basic principle of forestry which has here been lost sight of in the past, and if some sure method of replacing the timber extracted in selection fellings cannot be found, selection fellings must cease, or be restricted to the removal of timber that is in danger of becoming overmature.

544. *Calculation of the rotation.*—According to the diameter curve compiled from ring countings on stumps by Mr. Wood (after correction to breast height girth over bark), teak in natural forest attains a girth of 6½ feet in 122 years, and 7½ feet in 157 years. The average quality of the locality in the Selection Felling Working Circle is much lower than that of the whole forest, and hence 160 years has been fixed as the rotation for the Selection Felling Working Circle.

545. *Calculation of the yield.*—The present condition of the crop is such that a direct application of a formula like Von Mantel's will give an unreliable

figure for the yield. Of the total growing stock of 3,111,977 cubic feet (enumerated over 3 feet girth limit), 1,275,978 cubic feet are over 6½ feet in girth, and 1,835,999 cubic feet are under 6½ feet girth. It will thus be seen that about two-fifths of the crop is mature or overmature, and the rate of increment on this mature and overmature portion is certain to be less than that of the portion not yet mature ; hence a direct application of Von Mantel's formula will give an over-estimate.

546. The policy to be followed is to regulate the yield so that it remains constant throughout the whole of one rotation, and so that all the overmature timber will be removed first. The state of the crop at the end of the rotation should be such that, owing to improvement of the forest by artificial regeneration in gaps, the yield in the second rotation should be greatly increased, and will consist entirely of mature timber between 6½ and 7½ feet in girth, and there should be no overmature timber. In order to achieve this it is prescribed that during the first rotation all overmature timber will be removed, and ultimately, before the end of the rotation, mature timber down to a 6½ feet girth limit will be exploited.

547. The yield during the rotation will therefore consist of—

(*a*) all timber at present mature and overmature, and

(*b*) the increment accruing on the rest of the growing stock.

548. All timber over 7½ feet in girth will be assumed to be mature or overmature ; and no increment will be reckoned on it.

549. As a basis for determining the correct yield, the increment on the rest of the growing stock will be assessed by Von Mantel's original formula. As there is a great shortage of growth under 3 feet in girth, the modification of Von Mantel's formula, which makes allowance for the unenumerated portion of the growing stock, will not be used.

550. The annual yield (Y) from the Mount Stuart felling series will therefore be

$$Y = \frac{Vo.}{R} + \frac{Vr.}{\frac{1}{2}R}$$

where Vo = Volume of growing stock over 7½ feet in girth, in cubic feet.

Vr = Volume of the remainder of the enumerated stock, in cubic feet.

$$\text{Therefore } Y = \frac{7,87,733}{160} \quad \frac{23,04,244}{80}$$

$$= 4,923 + 28,803 = 33,726 \text{ cubic feet.}$$

As no increment has been reckoned on the overmature stock, as no allowance has been made for the unenumerated part of the growing stock, and as the rotation of 160 years is very liberal, the yield of 33,726 cubit feet, is probably not excessive. Nevertheless, to be on the safe side, it is considered desirable to limit the fellings to approximately one per cent of the growing stock ; and therefore 32,000 cubic feet per annum, equivalent to 1·02 per cent of the growing stock will be adopted as the basis for regulating the yield.

551. *Regulation of the yield in the Mount Stuart Felling Series.*—The yield will be regulated by area and no definite volume yield is prescribed. Coupes will be laid out by reduced areas so that approximately the correct annual yield will be obtained by felling down to a given girth limit. It is possible to do this because a 100 per cent enumeration of the area has been carried out, and it is considered that no volume limitation will be necessary, since the girth limit and the felling cycle will be adjusted so as to give the correct yield. If in actual practice more than the calculated yield is obtained, the reason will probably not be the inaccuracy of the enumeration, but the probable error in applying volume tables which are based on insufficiently accurate data for working out the volume of the growing stock from the enumerations. Since this error would apply proportionately to all the calculations for the yield,

an excess in the actual yield from fellings does not indicate overfelling, but merely that the volume tables are inaccurate. It is on account of this probable inaccuracy that no definite volume limitation is prescribed, but if such limitation is considered necessary, it may be prescribed, after three or four years working, by which time sufficient data will have been collected to determine by how much the forecasted yield should be increased or diminished.

552. *Determination of the felling cycle.*—Sylviculturally, both from the point of view of removing the overmature timber as quickly as possible, and in order to obtain an even series of age classes, the shorter the felling cycle the better. There are, however, two limiting factors, namely, (*a*) the rate at which the road system can be developed and (*b*) the size of the annual coupe from the point of view of easy management. The road system is planned so that it will be completed in 28 to 30 years, and hence the shortest felling cycle that can be adopted is 30 years. The nearest submultiple of the rotation is 32 years, but this is found to be inconveniently short because—

(*a*) the size of the coupes would be too large for convenient working under a system of artificial regeneration of gaps with the staff and labour supply at our disposal;

(*b*) it would involve an unnecessarily high girth limit (over 8 feet), in order to obtain the correct yield; and

(*c*) all the enumerations have been worked out and cover maps posted for the volume of timber of 7½ feet girth breast height and over, which is a convenient girth for exploitation.

The lowest convenient submultiple of 160 years which will fit in with a 7½ feet girth limit to give the required yield is 40 years, making the average area of the annual coupe 181 acres,—a conveniently manageable size. A 40-year felling cycle will therefore be adopted.

553. *Determination of the girth limit for fellings.*—With a girth limit of 7½ feet, the quantity of timber that will be removed during the felling cycle of 40 years will be—

(1) the entire stock over 7½ feet in girth,

(2) a half of the stock that passes the 7½ feet girth limit during the cycle;

(3) the increment accruing on a half of (2) at 1 per cent per annum. An analysis of the growing stock justifies the assumption that the transition period from 6½ feet to 7½ feet in girth is roughly 30 years. The total quantity removed during the felling cycle will therefore be—

$$(787{,}733) + \left(\tfrac{1}{2} \times 488{,}245 \times \frac{40)}{30}\right. + \left(\frac{40}{100} \times \tfrac{1}{2} \times \frac{488{,}245 \times 40)}{30}\right. = 787{,}733 +$$

$$325{,}497 + 130{,}199 = 1{,}243{,}429 \text{ cubic feet.}$$

This quantity divided by the felling cycle of 40 years gives an annual yield of 31,086 cubic feet which is less than the calculated annual yield by 914 cubic feet or 2·8 per cent. The difference between the two figures is immaterial and hence a 7½ feet girth limit will be adopted during the first felling cycle. Towards the end of the first felling cycle, the progress of the fellings will have to be watched carefully to see that they fit in so that the whole area will have been covered in the prescribed forty years. Some adjustment of the girth limit for fellings may be found necessary in order to effect this without altering the yield. In the second and subsequent felling cycles the yield will have to be successively reduced until the adopted value for the exploitable size is ultimately reached.

554. Ten coupes have been marked on the map for the period covered by this plan, and these coupes will, if worked in the prescribed order, give approximately equal annual yields of 7½ feet and over.

SECTION 6.—MOUNT STUART FELLING SERIES—METHOD OF EXECUTING THE FELLINGS.

555. The annual coupes which have been marked on the map will be laid out on the ground, demarcated by a cut line and surveyed. Care must be taken that the surveys are accurate, and that sufficient reference is made to topographical features while surveying to enable the plotted boundaries to be correctly placed on the Control Map.

556. *Marking for felling.*—All trees of saleable species of 7½ feet girth (at breast height over bark) and over will be marked for felling. The rules for numbering and enumeration, are the same as for the Clear-felling Working Circle, vide paragraphs 424 and 425 supra.

557. *Extraction plan.*—At the time of marking, a detailed extraction plan must be drawn up for the coupe showing the location of drag paths and cart-tracks on the 12-inch scale map. Short cart-tracks should be laid out into the coupes in such a way as to reduce dragging as far as possible.

558. *Felling, conversion, and extraction.*—Felling will commence as early as possible, and will be completed, and all timber extracted from the coupe by the end of September. The other regulations for felling, conversion and extraction are the same as for the Clear-felling Working Circle (vide paragraphs 423 to 437).

SECTION 7.—MOUNT STUART FELLING SERIES—SUBSIDIARY SYLVICULTURAL OPERATIONS.

559. *General.*—It having been proved that natural regeneration is insufficient for the preservation or improvement of the forest when worked by selection fellings, artificial regeneration of the gaps in the canopy in each year's selection coupe is prescribed as an experimental measure. After four years of this experimental gap regeneration, the position will be reviewed, and the prescriptions revised in accordance with the experience acquired. (Should the method prove a failure, then the felling prescriptions will have to be revised, so that no timber is removed except what is overmature or is likely to become overmature within the course of a few years. Intensive improvement fellings, experiments in encouraging natural regeneration, and other means of improving the state of the forest would have to be carried out, and regular exploitation of mature timber must not be recommenced until some certain means of preventing the degeneration of the forest under selection fellings have been discovered.)

560. *Aims of the method.*—The aims of artificial gap regeneration are—

(*a*) to prevent the deterioration of the forest when worked under selection fellings ;

(*b*) to improve the condition of the forest by increasing the stock and the proportion of valuable species through the establishment of a regular series of age-classes of these more valuable species.

In order to achieve this, the number and size of the gaps in each year's coupe must be as great as possible, and must be more than sufficient merely to replace the timber extracted.

561. *Objects of the measures prescribed.*—The objects of the measures prescribed are—

(*a*) To find out the best methods of carrying out gap regeneration on a large scale, in areas unsuitable for clear-felling and concentrated regeneration.

(*b*) To ascertain how far it is necessary to make gaps artificially or to enlarge existing gaps.

(*c*) To ascertain how much the operation costs when done on a large scale.

(*d*) To ascertain what staff and labour are necessary to carry out the operation.

(*e*) To find out how much supervision is required.

(*f*) To find out how much tending is required, and what is the best method of carrying out this tending.

(*g*) To ascertain whether gaps when once established will continue to thrive, or whether they will be liable to suppression by the overgrowth of the surrounding forest, and if so how much tending will be required to prevent such suppression.

562. *Selection of the gaps.*—In October each year the District Forest Officer will go over the selection felled area, and select and mark with numbered pegs as many suitable gaps as possible. The aim should be to regenerate all gaps that are large enough for the purpose, and at least a sufficient number to ensure that the stocking of the forest will be markedly improved. The minimum size of the gaps in the canopy should be at least 25 feet by 25 feet. The larger they are, the easier they will be to regenerate successfully, and if necessary they must be enlarged by cutting bamboos or girdling overhanging trees of useless species. When sufficient natural regeneration already exists in a gap, no artificial regeneration need be done.

563. The positions of the gaps will be marked on the 12-inch map.

564. *Billeting and piling.*—During October and November the branchwood of the felled trees and all inflammable material will be cut up and made into a pile in the centre of each gap. The piles should be low and flat, so as to cover as large an area as possible, and so as not to give too hot a burn. They should not be more than about 4 feet high. If the pile is made small and high, a very fierce burn over a small area is obtained which bakes the ground to a clinker upon which teak or other seeds will not thrive. A large flat pile gives an ideal burn. The piles will be left to dry for one or two months before being burnt.

565. *Burning.*—The aim should be to fire the piles as early as is compatible with a good burn ; the earlier this is done, the easier it will be to control any escaping fire and prevent damage to the rest of the forest. Fire protection of each individual pile should not be attempted, as it is expensive and impracticable. It is sufficient if a line is fire-traced round the whole of the area to be regenerated. It is therefore prescribed that the coupe boundary line will be cleared and burnt to a width of 12 feet before burning the piles in the gaps. It is suggested that about the first week in January will be the correct time to burn the piles, but the best time must be ascertained by experiment. At the time of firing the piles, a sufficient staff of coolies must be employed to prevent any fire from escaping from the area into the surrounding forest.

566. During the burn, other places within the area may by chance be well burnt in gaps. These should also be given numbers and regenerated.

567. *Staking.*—During February and March the ashes should be spread over the whole of the ground in the gap, and stakes at approximately 4 feet espacement should be put in by eye. There is no necessity to waste time in measuring the espacement of the stakes but they should not be closer than 3½ feet.

568. *Sowing and planting.*—Three species will be used for regenerating the gaps, namely, teak, *Dalbergia latifolia*, and *Pterocarpus marsupium.*

569. The teak will be put in the centre of the gap as it is a light demander, and the other two species round the periphery. It is essential that every teak plant gets direct overhead light.

570. Teak will be introduced by planting stumps, and steps must be taken to see that sufficient stumps are got ready for the operation. Approximately 20 to 30 stumps will be required for an average gap. The *Dalbergia latifolia* and *Pterocarpus marsupium* will be sown at stake, in loosened patches round the edge of the gaps at the beginning of June, and teak stumps will be planted as soon as the south-west monsoon is established and the ground is soft. Stump planting of *Dalbergia latifolia* and *Pterocarpus marsupium* may also be tried as an experiment. The preparation of the stumps and method of planting

them are fully described in Chapter II, paragraphs 468 and 469, and 478 to 480. The necessity for firm planting and for ensuring that the earth is in tight contact with the roots of the stumps is again emphasized.

571. *Weeding and tending.*—It is inadvisable to prescribe definitely the details of weeding and tending, and these are left to the discretion of the District Forest Officer, who will order them as the necessity arises. The aim must be to get the gaps well stocked with healthy seedlings as far advanced as possible at the end of the first year so as to obviate the necessity for replacements and excessive tending in the second year. In theory, if the right kind of burn is obtained, very little weeding ought to be necessary, owing to the sterilization of the soil. In practice several weedings will be required, especially just outside the burnt area, but it is hoped that as experience is gained in piling and burning, the amount of weeding required during the first two years will become less. Particular care must be taken to see that the *Dalbergia latifolia* and *Pterocarpus marsupium* seedlings round the periphery of the gaps are kept free from the weeds and creepers which will invade the gaps from the surrounding forest.

572. Some tending will be required in the second year, as it has been found that established regeneration, if left untended, scarcely progressed at all in the second year.

573. The Forest Research Officer is conducting experiments to determine the effects of clean scrapings and other methods of weeding in such gaps, and he should be consulted.

574. The best method of carrying out and supervising the tending of the gaps must be discovered by experiment. It is suggested that one subordinate (an intelligent forest guard or forester) should be made responsible for the tending and should be given a sufficient number of coolies to enable him to keep all the gaps sufficiently well weeded. It has been found that one subordinate with three female coolies can thoroughly weed nine gaps in a day. The question of encouragement of the subordinate in charge of tending by a reward for every fully stocked gap at the end of the season should also be considered.

575. It must be borne in mind, however that this is an experimental measure and that success is more important than economy. It is better in such a case to spend at first rather more than is necessary on weeding and tending in order to ensure success rather than to risk failure through motives of economy. After complete success has been attained and the correct technique evolved, steps can be taken to reduce costs.

576. The District Forest Officer will keep a careful record in the Regeneration Ledger of the following points :—

(*a*) Number of trees felled, and volume of timber extracted from the area.

(*b*) Number of gaps selected and regenerated.

(*c*) Cost of each operation and amount of labour required.

(*d*) Number of gaps considered to be successfully stocked in March in the year after formation, and in March two years after formation.

A narrative account of the operations giving details of work actually done, with remarks and suggestions, will be kept in the Control Journal, special attention being paid to the objects of the measures prescribed which are noted in paragraph 561 above.

577. *Financial aspect of gap regeneration.*—It is estimated that the formation and tending of gaps on a large scale should not cost more than Rs. 2 each. This expenditure must be regarded as a part of the exploitation cost of the coupe, since if gap regeneration is not done, we have no right to fell and remove any timber. Supposing that each tree removed has an average volume of 60 cubic feet, worth, on an average, Re. 1–4–0 per cubic foot. The value of this tree is Rs. 75 and the net revenue after deducting extraction costs and overheads at 12 annas per cubic foot is Rs. 30. This sum of Rs. 30 must be regarded as unearned income, being as it were, a present from Nature.

We are not entitled to accept this present without ensuring that the forest will not be depleted, and therefore, as much of this Rs. 30 as is necessary for the maintenance and improvement of the forest must be spent before the balance is credited to Government. In practice it is anticipated that each gap will cost approximately Rs. 2 to regenerate and that the result will be at least one tree of the same value as the one removed. (Actually the tree will usually be of a more valuable species, and it is anticipated that two or more trees may in some cases be produced where only one tree was originally removed.) Hence Government harvests Rs. 28 on the first tree removed, and after one rotation, a further sum of anything between Rs. 35 and Rs. 100 will be available for no extra cost. In theory we are entitled to spend a large part of the net value of the original tree removed (Rs. 30) in ensuring the maintenance and improvement of the crop, but in actual practice only a small fraction of that sum will be spent.

SECTION 8.—ULANDI FELLING SERIES—METHOD OF TREATMENT.

578. *General.*—For the reasons given in section 3, paragraph 535 above, the Ulandi and Palakadavu blocks cannot, at present, be worked on the basis of a sustained annual yield, though this may become possible when the state of the forest, which is at present very understocked, has been improved by regenerative measures. At present, our object being to extract mature and overmature timber as quickly as possible and to restock the area, and since facilities for extraction may only continue for a limited number of years, perhaps ten, our policy must be to work over the forest as quickly as possible and remove all overmature timber, and timber that is likely to become overmature within one felling cycle. It is advisable therefore to work as large an area as possible during the first few years. Over-felling will be prevented by fixing the felling cycle during which no area may be felled over more than once, and by fixing the girth limit for selection fellings.

579. *Exploitable size.*—Owing to the abnormally large quantity of overmature timber and the deficiency of lower age classes the girth limit for the first felling cycle is fixed at 7½ feet, though when the forest reaches a state of normality it will probably be nearer 6½ feet.

580. *Choice of species.*—Teak and *Dalbergia latifolia* are the only two species which show a reasonably large profit on exploitation when extracted via the Cochin Tramline. Other superior species, such as *Terminalia tomentosa*, *Terminalia paniculata*, *Lagerstrœmia lanceolata*, etc., scarcely clear the cost of extraction, but should be extracted if it is possible to do so without incurring a loss.

581. For regeneration teak will be the principal species. It may not be possible to arrange for the introduction of *Dalbergia latifolia* and *Pterocarpus marsupium* in areas that are clear-felled and regenerated by contractors, but the necessity for obtaining a mixture with these as the chief auxiliary species must be borne in mind, and if possible they must be introduced.

582. In areas where gap regeneration is being done, *Dalbergia latifolia* and *Pterocarpus marsupium* will be introduced round the periphery of the gaps, planting teak in the centre, as prescribed for the Mount Stuart Felling Series.

Sylvicultural System.

583. The sylvicultural system will be selection fellings with artificial regeneration of the gaps, and in addition clear-felling and concentrated regeneration of at least 50 acres a year in areas suitable for planting with teak.

584. The areas suitable for clear-felling and planting have been marked on the map, but are not separated off as a different working circle, because selection fellings will have to be done even in the areas suitable for clear-felling in order to obtain the necessary outturn for profitable working. As soon as an area has been clear-felled, it will be transferred to the Ulandi Felling Series of the Clear-felling Working Circle. It is impossible to mark out this working circle in advance.

585. In the event of fellings either by contractors or by the department becoming impracticable owing, for instance, to the closure of the Cochin Tramway or to any other cause the concentrated regeneration of 50 acres per annum should nevertheless be continued in order that the forest may be improved and brought to a state of normality. In such a case the operations should be done in some of the areas of almost pure bamboo, where there is but little timber to extract. Many such areas are of excellent quality and suitable for raising plantation of teak.

586. Normally it will probably be most convenient to do the clear-felling and the concentrated regeneration within the selection felling coupe of the same year. Gap regeneration should not be done in areas which are likely to be clear-felled in the near future.

587. *Rotation.*—The rotation is arbitrarily fixed at 160 years for selection fellings. Areas which have been regenerated and transferred to the Clear-felling Working Circle will be worked on a 100-year rotation as in the Mount Stuart Felling Series.

588. *Felling cycle.*—The felling cycle for selection fellings will be 40 years, as in the Mount Stuart Felling Series.

589. *Regulation of the fellings.*—No attempt is made to calculate a regular annual yield, on account of the abnormality of the growing stock and owing to the fact that a regular sustained annual yield will be too small for economic working. Fellings will be controlled by sylvicultural considerations, inasmuch as the abnormally large amount of timber which is overmature will all be removed during the first felling cycle. The area to be felled over each year, and the quantity of timber to be removed will not be restricted, except in so far as no timber under a 7½-foot girth limit will be removed, and no area will be worked over by selection fellings more than once in the felling cycle.

590. The coupes, both for selection felling and clear-felling each year will be selected by the District Forest Officer. The area (not less than 50 acres) to be clear-felled and planted will be demarcated. The selection felling coupe will then be determined by enumerating the trees over 7½ feet girth, until the required total yield is obtained, according to the quantity which the contractor working at the time can remove. As stated above, in paragraph 586 the clear-felling area will normally be within the selection area, but this is not imperative, as it may be convenient or advisable to extend an area previously cleared and planted, or to exploit a small isolated block of mature timber.

591. Enumeration for felling will be carried out as prescribed for the fellings in the Mount Stuart Felling Series (vide paragraphs 424 and 425 above). If the extraction is being done by contractors, there is no necessity to make out an extraction plan. The rules for demarcation of coupes and compartments, fixing compartment boards, and for the date of completing enumerations are the same as for the Mount Stuart Felling Series (vide paragraphs 389 to 393 and 425).

592. Felling and logging will usually be carried out by contractors. If done departmentally the rules and prescriptions made for the Mount Stuart Felling Series will apply.

SECTION 9.—SUBSIDIARY SYLVICULTURAL OPERATIONS.

593. *Gap regeneration.*—All gaps caused by selection fellings or occurring from other causes in each year's selection coupe will be regenerated artificially. The details of regeneration will be the same as for the Mount Stuart Felling Series. It is suggested that the reasons for the localized distribution of teak in the Palakadavu block should be investigated, as the results of such an investigation might prove to be of considerable practical value in their application to the sylviculture of teak. It is also suggested that investigations might profitably be carried out to determine whether the production of root suckers from timber species can be induced to a sufficient extent by digging trenches round the trees, to render it a practical method of improving the regeneration in the Selection Felling Working Circle.

594. *Concentrated regeneration of clear-felled areas.*—This will be done by contractors raising ponam crops if the opportunity offers, the teak being introduced by planting stumps at an espacement of 6 feet by 6 feet. The department will supply the contractor with sufficient stumps for regenerating the area, and for replacing casualties as and when required. Regulations regarding the crops to be raised and the times at which the contractor must introduce them and the teak stumps are not laid down here, as they will depend upon the conditions of the agreement which the contractor is willing to accept. It is however definitely prescribed that when the area is handed back to the department by the contractor, it will be stocked with established healthy teak plants at an espacement of not more than 6 feet by 6 feet, the percentage of stocking being not less than 90 per cent at the above espacement. It is undesirable that any large areas of clear-felling should remain unstocked with teak plants for as much as a year after felling, and if it appears that the contractor is going to fail in the teak regeneration during the first year, departmental steps must be taken to remedy the defect not later than the month of September in the first year. Provision should be made in all contracts for carrying out at the contractor's expense such replacements as are necessary to obtain the specified percentage of stocking of established plants in the event of his failure to do so.

595. *Departmental concentrated regeneration.*—Departmental regeneration of clear-felled areas will be carried out if opportunities for getting it done by contractors do not occur. The method of regeneration will be the same as in the Mount Stuart Felling Series of the Clear-felling Working Circle.

596. *Subsequent tending.*—Subsequent tending will be carried out as prescribed for the Mount Stuart Felling Series in both Selection and Clear-felling Working Circles.

597. *Thinnings.*—Plantations will be inspected to see if they require thinning in their fifth, eleventh, seventeenth, twenty-ninth and forty-ninth years after formation and if thinnings are required, they will be carried out in the sixth, twelfth, eighteenth, thirtieth and fiftieth years after formation.

598. *Other sylvicultural regulations.*—All prescriptions made regarding other sylvicultural operations in the Mount Stuart Felling Series of both the Clear-felling and the Selection Felling Working Circles apply also to the Ulandi Felling Series (vide paragraphs 440 to 446 and 559 to 576 above).

SECTION 10.—CONTROL.

599. The following control records will be maintained separately for the Selection Felling Working Circle :—

(*a*) *Control Book.*—Entries to be made separately for the Mount Stuart Felling Series and the Ulandi Felling Series. In the latter case, separate entries will be made showing the outturn from selection felling and clear-fellings in the Ulandi and Palakadavu blocks. Instruction regarding the maintenance of the Control Book are given in paragraph 719.

(*b*) *Record of Works.*—Entries to be made separately for the different felling series within the working circle. The method of maintenance is given in paragraph 720.

(*c*) *Gap Regeneration Ledger.*—Will be maintained separately for the Mount Stuart and Ulandi Felling Series as described in paragraph 721, and Appendix D-11.

Other control records common to all working circles, namely, the Compartment History, Control Maps, Fire Maps, and Control Journal, will be kept as described in Chapter VII, section 12, in respect of this working circle. The costs of nursery work done for raising stumps for gap regeneration will be entered in the Nursery Ledger for the Clear felling Working Circle, and the regeneration of clear-felled areas in Ulandi will be recorded in a separate book of the Regeneration Ledger as prescribed for the Clear-felling Working Circle (vide paragraphs 518 and 721).

SECTION 11.—TABULAR STATEMENT OF OPERATIONS.

600. *Tabular statement of fellings.*

SELECTION WORKING CIRCLE.

Mount Stuart felling series.

Year of felling.	Year of gap regeneration.	Coupe number.	Compartment and sub-compartment.	Area in acres.	Estimated outturn over 7½ feet in girth in cubic feet.			
					Teak.	Rosewood.	Other marketable species.	Total.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1931 ..	1932	I	Compartment 75 *c*	48·36				
			,, 53 *b*, *c* & *d*.	40·36				
			,, 52 *b*.	59·12				
			,, 40 *b*.	13·78				
			,, 37 *d*.	34·76				
				196·38	9,623	2,954	19,525	32,102
1932 ..	1933	II	Compartment 38 *b*.	73·25				
			,, 29 *e*.	61·31				
			,, 29 *f*.	19·38				
			,, 26 *d*.	23·82				
			,, 26 *b*.	7·64				
			,, 26 c.	6·67				
			,, 25 *d*.	22·16				
			,, 25 *e* (part).	55·10				
				269·33	10,896	1,380	19,724	32,000
1933 ..	1934	III	Compartment 25 *e* (part).	17·40				
			,, 25 *f*.	8·54				
			,, 32 *b*.	41·59				
			,, 31 *c*.	42·66				
			,, 31 *d*.	4·18				
			,, 24 *c*.	2·13				
			,, 24 *d*.	39·20				
			,, 24 *e*.	8·27				
			,, 24 *f*.	4·18				
				168·15	13,975	1,777	16,096	31,848
1934 ..	1935	IV	Compartment 28 *c*.	39·09				
			,, 28 *d*.	2·22				
			,, 28 *e*.	7·56				
			,, 28 *f*.	33·78				
			,, 22 *b*.	21·76				
			,, 22 *c*.	25·16				
				129·57	8,656	1,468	22,449	32,573
1935 ..	1936	V	Compartment 1 *b* & *c*.	89·16				
			,, 2 *b*.	143·02				
			,, 3 (part).	123·24				
				355·42	8,369	606	23,025	32,000
1936 ..	1937	VI	Compartment 4 *a* (part).	226·14	9,586	800	21,614	32,000
1937 ..	1938	VII	Compartment 3 (part).	130·98				
			,, 4 *a* (part).	17·60				
			,, 5 *a* (part).	11·55				
			,, 6 *c* ..	21·40				
			,, 6 *b* (part).	79·84				
				261·37	10,400	231	21,507	32,138
1938 ..	1939	VIII	Compartment 5 *a* (part).	128·98	14,766	1,329	15,905	32,000

600. *Tabular statement of fellings*—cont.

Selection Working Circle—*cont.*

Mount Stuart felling series—cont.

Year of felling.	Year of gap regeneration.	Coupe number.	Compartment and sub-compartment.	Area in acres.	Estimated outturn over 7½ feet in girth in cubic feet.			
					Teak.	Rosewood.	Other marketable species.	Total.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1939	1940	IX	Compartment 6 *b* (part).	38·49				
			,, 7 *c* ..	15·82				
			,, 7 *e* ..	62·76				
				117·07	12,792	834	18,374	32,000
1940	1941	X	Compartment 7 *d*.	32·89				
			,, 9 *d*.	18·84				
			,, 9 *e*..	16·69				
			,, 9 *f*..	88·83				
			,, 11 *c* (part).	66·14				
				223·39	2,010	912	29,078	32,000

CHAPTER IV.—WORKING PLAN FOR THE KARIAN SHOLA WORKING CIRCLE.

Section 1.—General Constitution and Character of the Vegetation.

601. *Area.*—The area of the Karian Shola Working Circle is 2,060 acres.

602. *General constitution.*—The working circle consists of a compact block of evergreen forest lying to the north-west of Topslip, with one or two small outlying portions.

603. *Character of the vegetation.*—The character of the vegetation has been described fully in Part I, Chapter II. The area is completely covered with pure evergreen high forest, with the exception of a few patches of bamboo, and one or two swamps. *Hopea parviflora*, *Mesua ferrea*, *Calophyllum tomentosum* and *Dysoxylum malabaricum* are the most valuable species in the shola. The distribution of these however is very variable. The undergrowth in most places consists of a dense mass of a species of *Strobilanthes*. The forest is many storied, and the ground is everywhere covered with a layer of humus, and is very effective in retaining moisture, and preserving the flow of water in the streams which find their sources in the shola. Natural regeneration of *Hopea parviflora* occurs abundantly in localized patches. *Mesua ferrea* regeneration is more evenly distributed, but not so abundant where it occurs. The natural regeneration of other valuable species is scanty.

Section 2.—Permanent Division of the Area.

604. *Blocks.*—The area lies partly in the Mount Stuart block and partly in the Tekkadi Leased Forest block.

605. *Compartments.*—The working circle is divided into compartments or parts of compartments, the boundaries of which follow natural features and are independent of the working circle boundary.

Section 3.—Temporary Division of the Area.

606. *Sub-compartments.*—Where part of a compartment lies within the Karian Shola Working Circle, and part in another working circle, sub-compartments will be formed for each portion.

607. *Coupes.*—The area will be divided into annual coupes as indicated below. These have been laid out on the map for ten years, and they will be demarcated on the ground as they are worked.

608. When any work is done in a compartment, the boundaries will be demarcated on the ground by a clear line, and compartment boards will be fixed at the corners as described in Chapter II, paragraph 393.

609. All temporary divisions of the area will be surveyed and marked on the 12-inch scale map.

SECTION 4.—ANALYSIS AND VALUATION OF THE CROP.

610. No analysis nor valuation of the crop is possible owing to the fact that the 'cruise' carried out by the late Logging Engineering division has proved to be inaccurate. This matter has been referred to already in paragraph 361 of Part I.

SECTION 5.—METHOD OF TREATMENT.

611. *General.*—This forest is to be kept primarily as a protective forest, and the method of treatment is to harvest some of the mature and overmature timber by very light selection fellings, with artificial regeneration of the gaps by sowing or planting evergreen species. The 'sine qua non' of any working of this area is that the evergreen character of the forest must be maintained.

612. The working must be regarded as experimental to a great extent. It is not yet known what evergreen timbers may be saleable, and what species can be easily regenerated either naturally or artificially, nor are the best methods of effecting such regeneration known. The present working is, therefore, on a very small and diffuse scale, and is more in the nature of a preliminary investigation into the working of evergreen forests. When markets are found for more of the evergreen timbers and when the technique of regenerating these forests has been established, more intensive working may become possible.

613. *Exploitable size.*—The following breast-height girth limits down to which timber may be felled have been fixed with reference to the size at which the trees tend to become unsound:—

Mesua ferrea—6 feet.
Hopea parviflora—7 feet.
Calophyllum tomentosum—9 feet.
All other saleable species—8 feet.

No fellings of timber below these girth limits may be done.

614. *Choice of species.*—For exploitation, any species may be extracted that are saleable or for which a market might be developed.

615. For regeneration the species to be tried are, in order of importance :—

Hopea parviflora, *Artocarpus hirsuta*, *Acrocarpus fraxinifolius*, *Mesua ferrea*, *Dysoxylum malabaricum*, and *Cedrela toona* : these may be supplemented by any other species found by experiment to be suitable. The aim must be to find those species which can be regenerated readily, and which at the same time realize the highest prices in the market. It is impossible to foretell the future requirements of the market, but it is quite probable that there will be a greater demand for general utility woods such as *Artocarpus hirsuta* or *Cedrela toona* than for woods required for a special purpose, (e.g., *Mesua ferrea* for sleepers).

616. *Sylvicultural system.*—The sylvicultural system will be very light-selection fellings, with artificial regeneration of gaps, supplemented by the tending of existing natural regeneration of *Hopea parviflora*.

617. *Rotation.*—In the absence of any statistics of the rate of growth of evergreen trees, the rotation is arbitrarily fixed at 150 years, as this is considered to be an ample time for trees to attain saleable dimensions. The accurate determination of the rotation is not, at present, necessary, since under the present system of working, where the quantity of timber removed is only a fraction of the possibility ; no calculation of the yield will be, or can be made.

618. *Felling cycle.*—In a system of working where all exploitation is governed by sylvicultural considerations, the advantages of a short felling cycle are obvious. Owing however, to inexperience in the treatment of ever green forests, and to the limited supervision and labour-supply available, large annual coupes cannot be attempted. The felling cycle is therefore fixed at 25 years, which gives an annual coupe of 82·4 acres, which is considered a conveniently manageable size.

619. *Calculation of the yield.*—Since the fellings are regulated and controlled entirely by sylvicultural considerations, no calculation of a sustained yield is either possible or necessary.

620. *Forecast of the outturn.*—A rough forecast of the probable outturn can however be made. It is laid down that not more than three trees per acre will be extracted (vide paragraph 623 below). The average volume of a tree, having an average girth of 7½ feet over bark at breast height is estimated to be about 125 cubic feet. Hence from a coupe of 82 acres, the maximum volume yield that can be expected is about 30,750 cubic feet. The yield from the different annual coupes, which are laid out equal in area, will be very variable. In some coupes the proportion of useful species may be so small that it will be impossible to find as many as three exploitable trees per acre in which case the yield will be considerably less than the figure given above. On the other hand many of the trees exploited may be of greater girth than 7½ feet, and the outturn may be correspondingly greater.

SECTION 6.—METHOD OF EXECUTING THE FELLINGS.

621. *Demarcation and survey of the coupes.*—Each year's coupe will be laid out on the ground from the map, demarcated by a cut line and accurately surveyed. The plotted survey will then be entered on the Control Map.

622. *Marking for felling.*—The following marking regulations will be carefully followed. Marking should be done by a competent Ranger who has been given personal instruction in the field by the District Forest Officer, and his work will be closely checked by the District Forest Officer or a gazetted assistant.

623. *Marking rules*—(*a*) *Girth limit.*—Timber of saleable species of not less than the following girth limits will be marked :—

	Girth over bark at breast height. FT.
Mesua ferrea	6
Hopea parviflora	7
Calophyllum tomentosum	9
All other saleable species	8

No timber below the girth limits specified above will be marked.

(*b*) *Number of trees to be marked.*—The total number of trees to be marked in a coupe shall not exceed three trees per acre. In a coupe of 82 acres, therefore, not more than 246 trees will be marked.

(*c*) *Distance apart of marked trees.*—No two trees within 20 yards of each other shall be marked for felling.

(*d*) As far as possible the largest trees, and the trees showing signs of becoming overmature through unsoundness should be marked first.

(*e*) As many trees as possible up to the specified number of three per acre will be marked provided that it is possible to do so without breaking rule (*c*) above regarding the distance apart of marked trees. If it is not possible to make up the quota by marking trees known to be saleable, the total number may be made up by marking trees of other species for which a market may be developed and which may in the future become saleable at a profit.

(*f*) No trees in this shola forest which have either been labelled as botanical specimens or as seed trees will be marked for felling.

624. The rules about the date of marking, numbering and measurement of trees, date of compiling marking lists, and the drawing up of an extraction plan, etc., are the same as those prescribed for the Clear-felling Working Circle (vide Chapter II section 6, paragraphs 423 to 427). For those species for which no volume tables have been prepared, the entry of the volume in column (8) of Form 3 should be omitted, since an eye estimate of the volume serves no useful purpose.

Felling, logging and extraction.

625. The felling will be conducted according to the general rules laid down for the Clear-felling Working Circle, section 6, paragraphs 428 to 438. The trees will be felled and extracted so as to do as little damage as possible to existing regeneration. It is probable that some timbers may sell better in one form than another. For instance, *Mesua* may sell best as sleepers, other species as 'kolmarams' or 'vittams,' and others as squared or round logs. The most saleable form for each timber must be found by experiment, and recorded in the Control Journal.

626. Fellings will be completed, and all timber will be extracted before the end of February.

SECTION 7.—SUBSIDIARY SYLVICULTURAL REGULATIONS—SEED COLLECTION AND NURSERY WORK.

627. *Seed collection.*—Seed of evergreen species will be collected from well-shaped vigorous, straight-grained trees of over 3 feet girth at breast height. Any particularly prolific and regular seed-bearers may be marked, and reserved against felling.

628. *Hopea parviflora.*—Abundant seed is available in good seed years, but in many years no seed at all is available at Mount Stuart. The seed ripens shortly before the monsoon and can be collected from the ground, which should be cleared beforehand. The seed is very perishable and must be sown in the nursery within 24 hours of collection. Fresh ripe seed, if sown immediately gives a very high percentage of germination.

629. *Mesua ferrea.*—Seed years are irregular, though in most years some seed is available. It may be collected off the ground, and the seed which falls in the first two weeks should be rejected. That which falls in the third week is the best, and should be collected. The seed only retains its germinating power for a short time.

630. *Chickrassia tabularis.*—There are a few trees of this species in the shola, and they produce seed abundantly most years. The capsules must be collected from the trees in January or early February before they open.

631. The following species either produce so little seed at Mount Stuart or are so rare in the shola, that their seed must be imported from other districts:—*Calophyllum tomentosum, Dysoxylum malabaricum, Acrocarpus fraxinifolius, Artocarpus hirsuta and Cedrela toona.* Seed of the latter species can be obtained from Punachi range, and it may be possible to collect sufficient *Artocarpus hirsuta* seed from the sholas in the Ulandi and Palakadavu blocks. For seed of other species, the Forest Research Officer should be consulted regarding the localities where they may be obtained and the times at which they are available.

632. *Nursery.*—A small nursery, sufficient in size to produce about 35,000 seedlings of all species annually will be required, i.e., about 35 beds 40 feet by 4 feet. A permanent site should be chosen which will serve year after year. Dense overhanging shade should be removed. The Forest Research Officer has obtained good results with evergreen nurseries right in the open, but it is probable that light shade may be desirable at certain times of the year. Drip must be avoided and any tendency of the beds to become sodden or stagnant during the rains must be counteracted by drainage and further removal of the overhead shade. It is probable that a nursery site right in the open with artificial shade will be best, as it is then easier to control the conditions of

moisture and shade, and to avoid drip. The Forest Research Officer should however be consulted on this point, as he is carrying out experiments in raising nursery seedlings of evergreen species. He should also be consulted regarding the best methods and times of sowing the various species in the nursery beds. Further valuable information on this subject can be obtained from records of the experimental work now being done by Mr. Kesava Vittal in the Tinnevelly evergreens. The nursery must be securely fenced against deer and bison, as most of the recommended species are greatly relished by them.

633. *Weeding and tending of nurseries.*—The weeding and tending of the evergreen nurseries will be carried out as prescribed for deciduous nurseries (vide Chapter II, section 8). If the nursery is under evergreen shade, the chief danger that must be guarded against is the water-logging of the beds during the rains, and steps must be taken to avoid this. Drip is also liable to cause the formation of cones of mud round the stems of small seedlings, which interferes seriously with their development. The retention of a light middle story has had a good effect in such cases. The beds must be kept completely free from weeds, the soil must not be allowed to become caked on the surface, and the seedlings must be thinned out before the beds become too congested.

SECTION 8.—REGENERATION OF FELLED AREAS.

634. Areas in which selection fellings have been carried out will be regenerated by planting up the gaps with evergreen species. The operation must be regarded as experimental, the aim being to discover what species can be most successfully raised in the gaps. The species to be tried are enumerated in section 5, paragraph 615 above.

635. *Preparation of the gaps.*—The gaps will be selected and marked with numbered stakes as soon as felling and extraction have been completed. This should be finished before the middle of March.

636. During the dry weather the gaps will be cleared of all branchwood, weeds, and seedlings of useless species. Any existing regeneration of valuable species should however be left and if the quantity of natural regeneration in a gap is considered by the District Forest Officer to be sufficient, no artificial regeneration need be done in it. There will be no piling and burning of branchwood in the gaps, since this has been shown to be definitely harmful to evergreen regeneration. *Strobilanthes*, if found in the gaps, will be cut down to ground level below the point at which the arching aerial roots join the stem. If this is done, the amount of regrowth will be very small. The gaps will then be staked at a rough espacement of 4 feet by 4 feet. This should be done by eye and time should not be wasted in measuring the distances between the stakes. The staking should also be continued into the surrounding forest for a distance of at least 5 yards all round each gap.

637. *Planting up the gaps.*—During the first rains of the monsoon the soil at each stake will be loosened with a pickaxe or other suitable implement to a depth of at least 1 foot. Seedlings from the nursery will then be transplanted into the gaps, one at each stake. It must be decided by experiment which species should be put in the centre of the gaps and which round the periphery, but *Acrocarpus fraxinifolius* should always be planted in the centre as it is a light demander, and grows rapidly during youth, forming a suitable light shade for the regeneration of other evergreen species beneath it. Planting will also be done in the forest to a distance of at least 5 yards around the gaps.

638. *Age of seedlings for transplanting.*—Experiments carried out by the Forest Research Officer indicate that generally 2-year old seedlings of evergreen species give better results than 1-year old seedlings, and that 1-year old seedlings are much better than 3 months old seedlings. Mr. Kesava Vittal however in his recent experiments in the artificial regeneration of evergreen species in Tinnevelly has obtained excellent results from 1-year old seedlings and in some cases better results from direct dibbling. One-year old seedlings should give sufficiently satisfactory results, and will be cheaper than 2-year old seedlings.

639. *Other methods of regeneration.*—Direct sowing of seed at stake in the gaps should also be tried. *Hopea parviflora* has in the past proved difficult to raise by this means in Karian Shola, but the abundant natural seedling regeneration which is obtained all over the ground beneath seed trees in a good seed-year indicates that it ought, if the matter is properly managed, to be quite possible to raise it direct by sowing at stake. It is moreover reported that *Hopea* regeneration by direct dibbling is very successful in South Kanara. *Chickrassia tabularis* and *Acrocarpus fraxinifolius* should also be easy to raise by this means.

640. Some species should also be suitable for raising by stumps. Two-year old stumps of *Artocarpus hirsuta* should be tried. The chief difficulty in regenerating this very valuable species is its slow growth to start with, its very great susceptibility to browsing and the fact that the seed is eaten by many animals. It is probable that if 2-year old stumps are planted out, the consequent more rapid growth will enable it to get away quick enough to survive the browsing. The Forest Research Officer is making further experiments in the best method of regenerating this useful timber tree artificially and he should be periodically consulted in the matter.

641. *Weeding and tending.*—The amount of weeding required is expected to be small, and one weeding and cleaning in August is probably all that will be required. The aim must be to establish the regeneration in the first year if possible, but, owing to the slow growth of many evergreen species, it is probable that tending may have to be continued for several years before the regeneration in the gaps can be said to be definitely established. Weeding and tending will be done as considered necessary by the District Forest Officer.

642. In the year in which the *Strobilanthes* flowers, special measures may have to be taken for the eradication of this pest, since otherwise in the following year, the ground will be thickly sown with the seed which is reported to retain its vitality for several years. Artificial regeneration in areas where the *Strobilanthes* has seeded will be difficult and expensive owing to the dense masses of seedlings which will come up and swamp everything else. This was clearly demonstrated in the experimental plots made by Mr. Conolly in 1926, in which various degrees of removal of the canopy, accompanied by clearing of weed growth were effected one or two years after the *Strobilanthes* had flowered. The result in every case was a solid mass of *Strobilanthes* seedling regeneration which effectively prevented any natural regeneration of tree species. It is not yet known what the best method of dealing with *Strobilanthes* at the time of flowering may be, but advantage must be taken of the next flowering of the species in order to discover the cheapest and most efficient method of preventing seedling regrowth in areas to be regenerated. The cutting back of the *Strobilanthes*, after flowering and before seeding, in the neighbourhood of gaps to be regenerated should probably be tried.

643. *Thinnings.*—The necessity for carrying out thinnings in the gaps should be considered at the next revision of the working plan. They should not be necessary for at least ten years after planting.

644. *Tending of existing natural regeneration of Hopea.*—In the area to be treated each year, the existing natural regenaration of *Hopea parviflora* will be stockmapped on the 12 inch scale. At the time when labour and supervision are most conveniently available, the patches of *Hopea* regeneration will be encouraged by the gradual opening of the canopy. The original instructions issued by Mr. Barry in 1925 regarding this operation are quoted below for guidance :—

> Cut all underwood except well-shaped seedlings and saplings of the best species : cut all trees in the middle story shedding too much shade. If under 2 feet girth fell them. If over 2 feet girth, girdle them. If there is still too much shade girdle a few useless trees in the upper story shedding too much shade . . . The object is to assist *Hopea* seedlings and at the same time to obtain more *Hopea* regeneration. In a couple of years time seedlings should be found beyond the present range of the mother trees and then more light can be admitted as in the group system. When the *Hopea* regeneration is 3 feet to 4 feet high, the remaining overwood must be gradually removed by girdling or felling the unsaleable trees.

645. Results of subsequent operations show that too much shade must not be removed in the first operation, and that if the *Hopea* regeneration is small, i.e., less than 3 feet in height, the first opening up should be confined to clearing the underwood and felling or girdling middle-story trees with large low branching crowns. Where the *Hopea* seedlings are very small or scattered, very little opening up should be done, but in the areas in which the *Hopea* growth is further advanced or denser, heavier removal of shade may be carried out. Since the removal of shade must be gradual, and since the benefits of a single operation will be lost if not followed up by subsequent tending, the whole shola will be gone over once every five years, as laid down in the tabular statement of operations. In each subsequent operation more light should be let in, and the latter operations, when the *Hopea* has attained the pole or sapling stage will be more in the nature of improvement fellings. It is important that the officer superintending the work should be well acquainted with the various evergreen species, so that he will not cut valuable species by mistake. In the past it has been frequently found that trees like *Aglaia roxburghii* or *Elaeodendron glaucum* have been cut unnecessarily. Tall straight poles with small crowns need seldom be cut. The operation should not cost more than about Rs. 1-8-0 per acre of actual *Hopea* regeneration treated.

646. *Climber cutting.*—A climber cutting will be done at the time of marking each coupe in the year previous to felling. All climbers in the coupe will be cut.

SECTION 9.—CONTROL.

647. The following control records will be maintained separately for the Karian Shola Working Circle :—

(*a*) The Control Book.
(*b*) The Record of Works.
(*c*) The Regeneration Ledger.

All the above will be maintained in the same way as for the Selection Felling Working Circle.

648. The Control Map will be maintained for this working circle and all coupes felled over will be surveyed and entered in it, with the date of felling. Artificial regeneration of coupes will be marked by small red circles representing the gaps regenerated. (The positions of these gaps should be accurately located and marked on the map.) A separate map will be maintained for *Hopea* tending. All areas in which *Hopea* regeneration occurs will be stockmapped as prescribed above (paragraph 644) and entered on the map, and the areas treated each year will be marked with red hatching, one series of lines for the first tending, two series for the second, etc., and the dates of working entered.

649. *Tabular Statement of fellings Karian Shola Working Circle.*

Year. (1)	Coupe number. (2)	Compartment and sub-compartment. (3)	Area. (4) acs.	Remarks. (5)
1931	I	67 *b*	82	For want of accurate data, it is not possible to make detailed estimates of outturn.
1932	II	67 *b* (part), 63 *b* (part)	82	
1933	III	63 *b* (part)	82	
1934	IV	63 *b* (part) and 60 (part)	82	The average annual outturn is estimated at 30,000 cubic feet approximately.
1935	V	60 (part)	82	
1936	VI	60 (part) 61 *d* and 62 *d*	82	
1937	VII	60 (part) and 58 *b* (part)	82	
1938	VIII	58 *b* (part)	82	
1939	IX	58 *b* (part), 59 *b* and 57 *a* (part).	82	
1940	X	57 *a* (part)	82	

650. *Tabular Statement of Hopea Tending Karian Shola Working Circle.*

1931 and 1936.		1932 and 1937.		1933 and 1938.		1934 and 1939.		1935 and 1940.	
Compartment.	Area.	Compartment.	Area.	Compartment.	Area.	Compartment.	Area.	Compartment.	Area.
8	7·82	54	263·47	56	227·38	58	121·50	62	20·80
10	49·61	55	195·29	57	184·00	59	25·29	63	200·18
14	18·76	..	..	..	..	60	206·58	66	21·25
15	108·71	..	..	..	..	61	54·31	67	88·69
45	25·42	..	..	..	..	..	..	68	3·73
49	30·75	..	..	..	..	..	..	..	..
50	133·68	..	..	..	..	..	..	..	..
51	72·00	..	..	..	..	..	..	..	..
Total ..	446·75	..	458·76	..	411·38	..	407·68	..	334·65

CHAPTER V.—WORKING PLAN FOR THE BAMBOO WORKING CIRCLE.

SECTION 1.—GENERAL CONSTITUTION.

651. The Bamboo Working Circle covers the whole of the area of the deciduous forest in the Mount Stuart and Tekkadi Leased Forest blocks, with the exception of the plantations already formed. The Ulandi and Palakadavu blocks are not included owing to their inaccessibility.

652. *State of the crop.*—The bamboos have seeded and died throughout the whole of the Mount Stuart forests between the years 1926 and 1930, with the exception of a few small areas here and there. Consequently it is impossible to lay down a series of annual coupes at present.

SECTION 2.—METHOD OF TREATMENT.

653. For the first five years of the working plan (1931 to 1935) the whole area of the working circle will be sold annually. In the fourth year (1934) an addendum to the working plan will be prepared prescribing bamboo coupes to be sold in rotation. If the area of mature bamboos available for exploitation is less than sufficient to supply the demand, the coupes will be worked on a three-year felling cycle. Otherwise the felling cycle may be longer.

SECTION 3.—METHOD OF EXECUTING THE FELLINGS.

654. In the case of clumps which are in flower or have flowered, no restrictions are placed on felling. Should there be any newly formed clumps in the five-year period, not less than five culms must be left in each clump, and no culm of less than two years' growth may be cut. When the flowered areas come into bearing, this restriction will become unnecessary.

655. The usual method of cutting the culms high up will be permitted, since it is impossible to enforce cutting within 2 feet of the ground without causing a very great drop in the prices realized for the bamboo coupes.

656. In areas where artificial gap regeneration has been done, or where natural regeneration occurs, the contractor will be held responsible for all damage done to regeneration or young tree growth in the course of the bamboo fellings.

SECTION 4.—CONTROL.

657. The area of each year's bamboo coupe, the number of bamboos extracted and the price realized for the coupe will be entered in the Control Book, a specimen form of which is given in Appendix D-3.

CHAPTER VI.—WORKING PLAN FOR THE MINOR PRODUCE WORKING CIRCLE.

658. *General constitution.*—The Minor Produce Working Circle covers the whole of the working plan area.

659. *Method of working.*—In order to be able to control to some extent the forest fires which originate through minor produce collection, and also in order to learn more about this hitherto much neglected source of revenue, departmental collection is prescribed. The area, therefore, will not be leased out to contractors as previously, excepting that portion of it included in the new Ulandi range, but the produce will be received by the range officer and paid for by him. He should collect representatives of the hill tribes and explain to them that no produce from the working plan area is to be taken to contractors in the future, but that all is to be brought to him, that he will pay fair rates, which incidentally will almost certainly be higher than those paid by contractors at present, and that they are not to fire the forest or to adulterate the produce collected in any way. If this is intelligently done and an interest taken in the subject it is certain that with the increased knowledge so gained a considerable improvement in both output and value will be eventually achieved. A list of different kinds of minor produce collected in the range, and the average prices paid by contractors in the past for collection is given in Part I, Chapter III, paragraph 152. The produce will be sold departmentally by whatever method realizes the best prices. The marketing is a subject that the Forest Utilization Officer must be periodically consulted about as it is one of much importance and the district staff is not in a position to be able to improve matters much without a certain amount of research and outside assistance.

660. A study should be made of the methods of collection, many of which appear to be very wasteful, and all practicable means of increasing the available quantity and of improving the quality of the products should be investigated. It is certain that this source of revenue is capable of very considerable development.

661. *Control.*—A control book will be maintained in which the quantities of each kind of produce, the average prices paid, and the revenue realized will be recorded. A sample form is given in Appendix D-4. The results of elephant capturing operations, and sales of elephants will also be recorded in the Control Book of the Minor Produce Working Circle.

CHAPTER VII.—MISCELLANEOUS REGULATIONS PRESCRIBED AND SUGGESTED.

SECTION 1.—SAFEGUARDS AGAINST OVER-PRODUCTION.

662. Apart from Ulandi, the timber from which cannot be marketed in Pollachi, the expected yield is 175,000 cubic feet. It is not at present certain that so much can be disposed of, and in order to guard against an accumulation of unsold stock it is prescribed that, when the total stock of logs in the depot reaches 100,000 cubic feet, further carting to Pollachi shall cease until the Conservator in consultation with the Forest Utilization Officer, decides to resume it. The latter officer should be advised when it is proposed to suspend carting, felled teak, *Pterocarpus marsupium* and *Dalbergia latifolia* may be held up in the forest but not other species.

663. Care must be exercised to ensure the disposal of stocks of timber which have been in the depot for two years.

664. In order to obviate felling in excess of the demand it is prescribed that the position be examined by the Conservator and Forest Utilization Officer in March, that is to say, before any fellings for the year are undertaken. If it is decided to restrict fellings, the subsidiary fellings should be stopped first, and if this does not reduce the output sufficiently, selection fellings in the Mount Stuart Felling Series will also be stopped.

665. It must not be supposed that the above prescriptions justify the retention of timber in the forest up to the prescribed limit of time. They do not justify any such procedure, and it is again emphasized that timber must be carted as soon after felling as possible.

SECTION 2.—ROADS.

666. In the past, the progress in road construction has not more than kept pace with exploitation, and the position is now that, with the exception of the clear-felling coupes and a few scattered areas for selection felling there are no areas immediately available for exploitation that are tapped by roads. Consequently for the next few years, road construction will have to proceed at an increased rate.

667. A complete road system within the forest has been drawn up, the total length of which is about 46 miles. Thirty-one miles of this have still to be constructed. The whole system must be completed before the end of the first felling cycle, so that every coupe is tapped. Hitherto the most inaccessible areas near Athalamman Koil, and the coupes near the Tekkadi end of the forest have not been worked for a very long time owing to the fact that no routes of extraction have been made into these areas. It is consequently desirable to tap these areas as quickly as possible, and hence a programme of rapid road construction is drawn up for the next ten years.

668. The completed system has been marked on the 12-inch map. It will have two outlet —one by the existing Top Slip ghaut road, and one by a new metalled ghaut road which will be constructed near Ayyasamimudi at the Tekkadi end of the forest. Owing to the necessity of working the coupes near the Tekkadi end as soon as possible, the construction of this new ghaut road must be put in hand immediately. Estimates are at present being prepared for it, and for the extension along the Gudaravalli valley to where it joins the existing cart-track. The portion of this cart-track from the point where the new road meets it, to its junction with the Top Slip Sethumadi road may have to be widened and metalled.

669. *Specifications.*—The roads within the forest will all be earth roads, 12 feet wide exclusive of side drains. It may later be found necessary to metal certain of the main portions of the system over which much carting has to be done. The projected Ayyasamimudi road will have to be metalled, at any rate over the ghaut portion.

670. *Gradients.*—The maximum allowable gradients will be 1 in 33 against the load and 1 in 20 with the load for unmetalled roads. The road system has been laid out on the map with these maximum gradients as shown by contours, but when constructing the roads, some deviation from the location shown on the map may be found necessary. The general rule in construction must be to follow the shortest route allowed by the specified gradients or other obstacles, provided that the general route shown on the map is not departed from too widely. Obligatory points, such as saddles on ridges must be adhered to and when tracing the roads for construction the trace should start at such obligatory points and should work away from them on either side.

671. The following ten-year programme of road construction will be carried out. The roads must be traced and estimates prepared in sufficient time to allow of their construction in the specified year.

Year.	Roads to be constructed.	Length (to nearest furlong). M. F.	Remarks.
1931	Sungam to Manjali Pallam (1 mile 2 furlongs) cross river by bridge; Up Manjali Pallam for half a mile, down Manjali Pallam for 6 furlongs.	2 4	Start trace from saddle beyond Sungam. Work back to Sungam, and on to Manjali Pallam.
1932	(*a*) Continue road along Manjali Pallam to the junction with the Tellikal branch.	1 7	
	(*b*) Commence reconstruction and regrading of road back from the top of the proposed new Ayyasamimudi Ghaut road towards Tekkadi.	1 1	
	(*c*) Renovate, widen, metal, and where necessary re-grade the existing cart track from the Top Slip-Sethumadi road (about one mile from Sethumadi), to the bottom end of the plains portion of the new Ayyasamimudi road.	2 4 (approximate distance).	This can be most conveniently constructed by the Pollachi Range staff.
	(*d*) Commence construction of plains portion of new Ayyaswamimudi Ghaut road.	0 6	Pollachi Range.
1933	(*a*) Continue top Tekkadi road past Tekkadi Forest rest-house (Elathodu) for a total distance of 2 miles 7 furlongs.	2 7	Partly reconstructing old cart-track.
	(*b*) Continue construction of Ayyasamimudi Ghaut road—complete the plains portion 7 furlongs and start the ghaut portion (9 furlongs).	2 0	Most conveniently done by Pollachi Range staff.
1934	(*a*) Construct branch cart-track from the saddle on Tekkadi road, north-east of Mangajam, to Shemanguli Pallam.	2 2	Some very difficult country.
	(*b*) Complete construction of the Ayyasamimudi Ghaut road. *Note.*—It is absolutely essential that the Ayyasamimudi Ghaut road be completed in 1934, so that carting may commence in 1935. Otherwise the order of the coupes will be upset.	0 5	Pollachi range.
1935	Continue road along the Tekkadi river southwards from the 1933 finishing point.	2 0	
1936	Continue the Sichali road from the 1930 finishing point westwards along the Sichalipallam crossing the Tunacadavu river by a bridge near the Sichalipallam junction.	1 6	To serve the clear-felling coupes.
1937	Continue the road along the Tekkadi river from 1935 finishing point, past Padiparai.	1 2	
1938	Continue same road, turning westwards	1 2	
1939	Construct branch road to the saddle by Punnamudi from near Padiparai, and on to junction of proposed branch road from Manjali Pallam.	1 0½	
1940	Construct road from near Sungam down the Tunacadavu river past the Sichali road junction.	1 2	

672. *Cost of the road system.*—The earth roads within the forest should not cost more than Rs. 2,000 per mile. The total cost of the interior road system yet to be constructed will be about Rs. 40,000. The cost of the Ayyasamimudi Ghaut road is roughly estimated to be not more than Rs. 35,000 including renovating the existing cart-track along the Gudaravalli valley. The total capital cost of roads in the next thirty years will be Rs. 75,000 the interest on which at a rate of 5 per cent gives an annual overhead of Rs. 3,750. The yield from these forests is estimated to be about 145,000 cubic feet per annum, of which about 73,000 cubic feet on the average will be more profitably extracted via Tekkadi. (This is probably an underestimate.) Hence the extra cost per cubic foot owing to the construction of new roads will be about 5 pies and less if, as is expected, the Raja of Kollengode contributes towards the initial cost of the proposed Ayyasamimudi road. More than half of this (namely the cost of the road system within the forest), is inevitable, since without these roads, the timber could not be extracted. The other portion which is

due to the cost of the new ghaut road (2 32 pies per cubic foot), is also revenue-producing expenditure, since if this road were not constructed the average cost of extraction from the coupes nearest to Tekkadi would be about As. 1–8 more per cubic foot than by carting down the new ghaut road. Hence by constructing this road a saving of about Rs. 4,100 per annum is being made during the first thirty years, allowing for maintenance of the ghaut road at Rs. 500 per mile per annum. At this rate, the road will have paid for itself in less than nine years. The saving will be immeasurably greater during the second rotation when the teak plantations come into bearing. Furthermore the road will be of great value to the Raja of Kollengode, as it will form a line of export from his territory, and will serve Tekkadi village ; it is anticipated that the Raja will be willing to bear a share in the cost of construction and of upkeep. He should be approached in the matter before the construction is undertaken.

SECTION 3.—MAINTENANCE OF EXISTING ROADS.

673. All roads must be maintained in good order, as it is less expensive to keep roads in good condition by small annual repairs, than to let them go without attention for several years and then have to incur heavy expenditure on extensive repairs. Provision must be made every year for the maintenance even of roads that are not actually in use during the year, in order to cover the cost of clearing side drains and small repairs. It is particularly important that the drainage system of all roads, and especially of roads not in actual use, be kept in perfect order. Money spent on efficient drainage is almost invariably an economy.

SECTION 4.—OTHER COMMUNICATIONS.

674. A bridle-path should be constructed from Top Slip to Tekkadi, through Karian Shola. It should be traced with a gradient not exceeding 1 in 5, and must be made passable for baggage elephants.

675. Extensions of the telephone line will also be made to Sungam and to Tekkadi in order to connect up these places with Top Slip.

SECTION 5.—BUILDINGS.

676. At Tekkadi (Elathodu) the existing quarters and the forest rest-house must be put in good repair. A new kitchen is required for the ranger's quarters and extra quarters must be built for accommodating two foresters and one depot-keeper. The old forest guard's lines should be put in good order and made inhabitable, and permanent coolie lines to accommodate 60 to 100 coolies should be built. Road construction works will start at Tekkadi in 1932, and timber exploitation in 1935. These building works must therefore be taken in hand immediately.

677. A serambi for officers conducting thinnings in the plantations should be constructed between Sungam and Tellikal, so that they can halt near the work. The site chosen should be near to a good water-supply, and at the same time should be as high up and as exposed as possible. The jungle should be completely cleared all round the serambi to a distance of at least 100 yards and kept clear.

SECTION 6.—MAINTENANCE OF BOUNDARIES.

678. All State and district boundaries will be maintained in accordance with the orders of Government in force at the time. The southern boundary of the Palakadavu block, which adjoins some lands recently assigned for tea cultivation, has not yet been finally surveyed and demarcated. A register of boundaries shall be maintained in which a correct description of all State, district and other exterior boundaries, with angles and field measurements will be recorded.

679. The boundaries of permanent compartments when they do not follow natural features, will be cleared whenever any work is being done in a compartment. Otherwise they will not be maintained.

SECTION 7.—FIRE-PROTECTION.

680. Complete fire-protection of the whole forest is of the utmost importance, since without it, we cannot hope to preserve the natural regeneration of tree species, or to regenerate artificially any selection felled areas with success. Fire-protection will take three forms, namely :—

(*a*) Protection of the outer boundaries of the area to prevent fires from entering the forest from without.

(*b*) Internal protection of artificially regenerated areas, including both plantations, and areas in which artificial gap regeneration has been done.

(*c*) Prevention of fires within the working plan area by the departmental collection of minor forest produce, and by the payment of rewards to the resident natives in the event of no fires occurring, or by exercising punitive measures if they allow or cause fire within the forest.

A. Protection against Fires coming into the Working Plan Area from outside.

681. This will consist of burning the forest along the boundaries between guide lines as specified below. The guide lines will be 8 feet broad in every case except on the eastern boundary adjoining Pollachi range, where the lines will be 12 feet wide. In certain cases the boundary of the forest or a road or river may serve as one guide line. All undergrowth, grass, weeds, bushes, etc., in the guide lines must be cleared and piled on the edge from which the burning will be done. The tree growth on the guide lines need not be cut. The clearing of guide lines must be completed by the middle of December. The forest between the guide line and the boundary should be burnt as early as it is possible to get a good clean burn. This will probably be about the beginning of February. A second burning in April may be found necessary in order to remove the carpet of dry leaves which will have fallen. The above dates are not prescribed definitely. It is left to the discretion of the District Forest Officer to do the burning when the conditions are favourable, and as often as is found to be necessary in order to make the forest absolutely safe from the invasion of fires from without. Since most of the forest to be burnt between the guide lines is of very poor quality and classed as unworkable, no harm will be done if the fire is a fierce one. Great care must however be taken that the fire does not escape from between the guide lines.

682. The following protection of the boundaries will be carried out as described above, for the Mount Stuart and Tekkadi Leased Forest blocks :—

(*a*) *Cochin boundary, from Vengolimalai to Pulalimudi.*—The Cochin boundary line along the ridge will be used as one fire-line and will be cleared. A guide line on the north side of the ridge not less than 200 yards away from it will be cleared, and the area between this line and the boundary line will be burnt as described above from the bottom upwards. (Distance 4·50 miles.)

(*b*) *From Pulalimudi to the junction of the Tunacadavu and Itti rivers at Tellikal.*—The Cochin boundary will be cleared as a fire-line, and the forest burnt between it and a parallel guide line of 100 yards from it. (Distance 0·86 miles.)

(*c*) *From Tellikal to Tekkadi.*—Cut a guide line as shown in the 12-inch map (about 100 yards from the river, but not following the curves of the river in detail), and burn to the river. (Distance 8·78 miles.)

NOTE.—When the new road is constructed, this can, in many places be used as the guide line, and the forest between it and the river can be burnt.

(*d*) *From Tekkadi to Ayyasamimudi.*—Use the existing road as a fire-line and burn from an 8-foot guide line 100 yards to the south of it. (Distance 1·12 miles.)

(*e*) *From the point where the above road meets the working plan boundary to Pandaravaraimalai.*—Cut two guide lines 8 feet wide and 100 yards apart, one on either side of the ridge via point 2,753 and Kathadi Mudi to the summit of Pandaravaraimalai and burn between them. (Distance 1·88 miles.)

(*f*) *From Pandaravaraimalai along the Pollachi-Tunacadavu range boundary to where it hits the ghaut road near the 14th mile 7th furlong.*—Cut two guide lines 12 feet wide, one of which should be the range boundary itself, and the other 100 yards from it, and burn between them. (Distance about 2·08 miles.)

(*g*) *From the 14th mile 7th furlong on the road to the Umayamalai-Vengolimalai ridge.*—Use the ghaut road as a fireline, and burn from a straight guide line 12 feet wide, about 100 yards to the east of it as shown on the map, as far as the bottom corner of the 1928 plantation. Thence burn between two guide lines 12 feet wide and 100 yards apart, the western one of which follows the outer edge of the 1928 plantation for a short distance and then joins the road again at the 18th mile 4th furlong. Thence using the road as one fire line, burn from a guide line 12 feet wide 100 yards distant on the eastern side as far as the hairpin bend at the 20th mile 5½ furlong. Thence cut two guide lines 12 feet broad and 100 yards apart due south as far as the bottom of the rocky precipice on the Umayamalai-Vengolimalai ridge and burn between them. (Distance 3·23 miles.)

(*h*) *From Umayamalai to Vengolimalai.*—Cut two 8-foot guide lines, one on either side of the ridge at least 100 yards apart and burn between them. The ends of these lines at Vengolimalai should be joined to the lines leaving Vengolimalai to the westward [see (*a*) above]. This line also serves to protect the Ulandi block and to prevent fires from the Ulandi block coming over into the Mount Stuart block, and vice versa. (Distance 3·84 miles.)

683. The total length of the circuit is therefore 26 miles 2·3 furlongs. Of this, however, about 2½ miles consists of rocky areas which need not be burnt. The length of guide lines to be cut and cleared is approximately as follows :—

8 feet guide lines, 23·8 miles.
12 feet guide lines, 7·6 miles.

(This includes double the length where two guide lines have to be cut, and omits lengths where the line crosses rocks.)

684. In order to reduce the number of dangerous fires that come over from the Pollachi range, it is prescribed that if any such areas on the borders of the forest treated in this working plan are burnt in Pollachi range, they will be closed to grazing for at least one year.

685. *Protection of the Ulandi and Palakadavu blocks*—(*a*) *From Umayamalai to the Varigali Ar.*—Cut two guide lines 8 feet wide and 100 yards apart at a bearing of S 10° E (— 170°) as far as the Murungali Ar. Then using the Murungali Ar as one guide line, burn between it and another line 8 feet wide cut 100 yards to the east of it. Parts of this will be in deciduous forest, and parts in dense shola. The line need not be cut in the shola portions nor need any burning be done there, provided that the District Forest Officer is satisfied that there is no danger from that quarter. The line will continue down the Murungali Ar until it reaches the Varigali Ar. (Distance 1·95 miles.)

(*b*) *From the Varigali Ar to the Periyar.*—Continue up the Varigali Ar for half a mile, using the river as one fire-line, and cutting an 8-foot guide line 100 yards away on the northern side if necessary. (This side of the river as far as could be seen from a distance, appears to be dense shola, in which no line may be necessary.) Then strike S 40° E (= 140°) for a distance of 5 furlongs to the saddle, cutting two 8-foot guide lines 100 yards apart. Then turn southwards, using the stream as one guide line and cutting another line 8 feet wide 100 yards to the west of it, so continuing to the junction of the Periyar with the Panatti Ar. (Total distance from the Varigali Ar to the Periyar is 3·61 miles, of which about 1½ miles is evergreen shola.)

As the Periyar is a large perennial river, it serves as an effective fire-line, and no fire tracing is required along it.

(*c*) *From Palakadavu to Vengolimalai.*—The portion of the Cochin boundary between Palacadavu and the Varigali Ar need not be maintained as a fire-line since fires are not likely to arise in the small part of Cochin included between these two rivers, which meet less than one mile west of the boundary. From the Varigali Ar, at a point about 75 chains upstream from the place where the Cochin boundary crosses it, two guide lines 8 feet wide and 100 yards apart will be cut in a north-north-westerly direction so that the westernmost of the two lines meets the corner of the Cochin boundary. Thence, using the Cochin boundary as one fire-line, cut a guide line 8 feet wide 100 yards to the east of it as far as Vengolimalai peak, where it will join the line along the Vengolimalai-Umayamalai ridge. (Distance 2 38 miles.) The forest between the two guide lines, or between the boundary and the guide line will be burnt annually.

686. The total length of the fire-lines in the Ulandi and Palakadavu blocks is therefore 7·94 miles involving approximately 11 miles of guide lines 8 feet wide. No fire-protection of the portion of Palakadavu block lying south of the Periyar is at present contemplated, as these forests contain very little valuable timber and have not so far been worked at all.

B. Internal Protection of Regenerated Areas—Plantations.

687. As stated in Chapter II, paragraph 507, all large compact blocks of plantations will be surrounded by a 50-foot fire-line where they adjoin natural forests which is not likely to be clear-felled in the near future (i.e., within about ten years). Such fire-lines will be clear-felled and all saleable timber removed. Unsaleable timber, bamboos and other growth will be cut and heaped in the middle of the line and burnt. The line will be kept absolutely clear of growth during the fire season, and fallen leaves must be swept into the middle of the line and burnt as often as is found necessary.

688. The boundaries of contiguous plantations will be maintained as internal fire-lines 12 feet broad, and all growth in them must be cut and burnt each year. The total length of such internal fire-lines is so great that they cannot be kept swept clean of leaves all through the season. Their main function is to provide a means of rapidly getting to places from which back firing can be done in order to control any fire which may have entered the plantations.

689. The outer edges of plantations adjoining natural forest which will be converted into plantation within about ten years, will be protected by a 12-foot fire-line which will be kept clear and patrolled regularly.

690. *Protection of areas in which artificial regeneration of gaps has been done.*—The boundaries of the regenerated coupes will be maintained as internal fire-lines for five years after the gap regeneration has been done. This line will be 12 feet wide and will be cleared of all undergrowth, grass, shrubs, weeds and fallen leaves, etc., at the beginning of the fire season. It will probably not be possible to patrol all such lines, and keep them clear all through the fire season. It should be realized however that if it is found that fires cannot be kept out of areas in which gap regeneration has been done, then it will be useless to attempt such regeneration, and consequently selection fellings would have to cease. It is therefore of the utmost importance to keep fires out of selection felled areas in which gap regeneration has been done, especially in the first ten years.

C. Fire Patrols.

691. The fire-tracing of all the boundaries in February will, if properly done, clear away all inflammable undergrowth for the whole of the fire season. There will, however, be a dense fall of leaves throughout the hot weather, which will, after a certain time, form sufficient litter to carry a fire across the belt which had been previously burnt. As soon as there is any possibility of fires coming across the protecting belt, it will be necessary to employ fire patrols to keep the guide lines clear and to be ready to put out any fires that may come across the boundaries. Such fires will not be very fierce as they will only be ground fires burning the fallen leaves and they should be easy to control. Fire patrols will also be required to keep the lines surrounding the plantations clear and safe.

692. The District Forest Officer will, therefore, employ fire patrols during the fire season for such a period of time, and of such numbers and in such places as is necessary for the complete protection of the forest from fires entering from without, and for the protection of regenerated areas from fires occurring within the forest.

693. The chief danger of fire entering from without occurs between Pulalimudi and Tekkadi, between Tekkadi and Pandaravaraimalai, and along the Pollachi range boundary from Pandaravaraimalai to the Vengolimalai-Umayamalai ridge. The disposition of fire patrols is left to the discretion of the District Forest Officer, but the following is suggested as being a suitable arrangement :—

(1) A gang of four men stationed at Elathodu (Tekkadi forest rest-house) two of whom will look after the line as far as Pandaravaraimalai, and two as far as Padiparai.

(2) A gang of two men at Athalamman Koil to look after the line between Padiparai and Pulalimudi.

(3) A gang of four men at Top Slip who will be responsible for the line from Pandaravaraimalai to the Umayamalai-Vengolimalai ridge.

(4) A gang of four men at Sungam responsible for the fire-lines round the plantations.

694. It will probably be unnecessary to patrol the line from Pulalimudi to Umayamalai, since any fires coming over the ridge can always be easily seen, and put out before they reach the edge of the workable forest.

695. The duties of fire patrols are—

(*a*) To patrol the fire-lines and to keep them clear of leaves and litter throughout their whole length.

(*b*) To watch Kollengode and Cochin fires.

(*c*) To prevent any fires from crossing the fire-lines.

(*d*) To put out any small fires noticed within the forest, or if they are too large for the patrol to put out, to report them immediately and to take a sufficient number of coolies to the fire as quickly as possible, and extinguish it.

696. It is necessary that the work of the patrols and all other fire-protection works be efficiently supervised, and the Range Officer is responsible for seeing that this is done. Sufficient subordinates have been allowed for this purpose, when estimating the staff necessary for carrying out the plan.

D. Prevention of Fires within the Range.

697. In order to reduce the chances of fires being started within the working plan area the following prescriptions are made :—

(1) Minor forest produce will be collected departmentally except in the area included in the new Ulandi range.

(2) Any one caught starting a fire either purposefully or accidentally will be prosecuted.

(3) Handsome rewards should be offered for capturing and producing culprits who have started fires.

(4) The jungle tribes should be persuaded to settle in various parts of the forest, and given land to cultivate ; at the same time they should be apportioned certain definite areas of the forest to protect from fire. The land for cultivation should be granted only on condition that they see that no fires occur in the portions of the forest which have been allotted to them for protection.

(5) Any paths which are found to be a source of danger, and from which fires frequently start should be fire-traced in February.

(6) Halting places for carts along the roads should be fixed, cleared and burnt. No carts should be allowed to halt in other places.

(7) Rewards should be given to the resident Kadirs and Malasars if no fires occur in the range throughout the season. If there is the smallest fire, no rewards at all should be given. Proportional rewards are objectionable as they defeat their own object which is the absolute protection of the forest. Probably the best method of giving rewards is to hold a Darbar in June, and to give a free feast to all if no fire has occurred within the year.

E. Miscellaneous Regulations for Fire-protection.

698. *Look-out tower.*—It usually happens that fires starting within the range, or entering the range from outside are not noticed until they have burnt for some time and have become well established. Top Slip, Anaipadi and Sungam are all badly situated for observing fires, especially those which start to the north and west of the large block of plantations near Anaipadi. It is suggested that a look-out tower, some 30 to 40 feet high, situated at a point of vantage, either on the ridge on the western edge of Karian Shola (point 2851) or further west on the ridge to the north of the plantations, or better still on the top of Periya Kathadi Mudi, be erected. If in the latter place, a high tower would not be required. The tower would have to be connected up by telephone with the present telephone system, but this would not be expensive as the line from Anaipadi to Tekkadi will go through Karian Shola in any case. Fires generally occur between 2 p.m. and 6 p.m. If this tower were occupied from 10 a.m. to 7 p.m., many fires could be seen and reported, and extinguished before they got out of hand. The cost of the tower, which, including the extension of the telephone line, should not be more than Rs. 150 to Rs. 200 would soon be saved in the reduction of the cost of extinguishing fires. It is therefore prescribed that, if during the next three years the number of fires occurring within the range seems to justify it, a look-out tower will be erected in the most suitable spot (probably Periya Kathadi Mudi would be best, since fires in the Tekkadi area can also be spotted from there), and will be connected up by telephone, and manned by two watchers from 10 a.m. till dusk.

699. *Timber depots.*—All timber depots within the range, whether on the roadside or in the coupe, will be protected by clearing and burning a line at least 8 feet wide all round them. Depots must be inspected periodically throughout the fire season to see that they are sufficiently protected against the danger of fire. Logs should not be left lying singly, or in twos and threes about the forest, but should be collected in large depots as far as possible. This also applies to spokes and felloes, and any other combustible produce stored in the forest.

700. *Cost of fire-protection.*—The following statement gives a rough estimate of the anticipated cost of fire protection :—

	RS.	A.	P.
(*a*) Cutting guide lines 8 feet wide—34·8 miles at Rs. 7-8-0 per mile.	260	0	0
(*b*) Cutting guide lines 12 feet wide—7·6 miles at Rs. 9 per mile ..	70	0	0
(*c*) Burning between guide lines—100 yards width for 31·7 miles, at Rs. 14 per mile	450	0	0
(*d*) Initial clearing of fire line 50 feet broad round large blocks of plantations, at a net profit of Rs. 1,000 per mile from sale of timber, average ¼ mile per annum .. .. *Note.*—One mile of line 50 feet wide covers about 6 acres.	plus 250	0	0
(*e*) Clearing 12 feet lines round plantations and areas of gap regeneration (cost is included in cost of regeneration)	Nil		
(*f*) Fire patrols for maintenance of the above lines—18 men at Rs. 15 per month for six months	1,620	0	0
(*g*) Miscellaneous (rewards, extinguishing fires, look-out tower, etc.).	250	0	0
Total ..	2,400	0	0

SECTION 8.—LIVESTOCK.

701. Elephants will be maintained for timber extraction. The present number (about 24 including elephants under training) should be sufficient, since the total annual quantity of timber to be extracted will be about the same as at present. Efforts should however be made to reduce the amount of dragging as far as possible by making cart tracks into the felling coupes.

702. *Care of elephants.*—The instructions laid down in the Madras Forest Pocket Book with regard to the general care and working of elephants should be adhered to. In particular, elephants should not be hobbled when they graze at night, except perhaps in very exceptional cases. A long drag chain on the hind leg is quite sufficient to enable the mahouts to find and bring back their elephants in the morning.

703. *Elephant-capturing.*—Elephant capturing operations will be continued on the same lines as at present. No pits may be dug in the plantations, owing to the damage that would be caused if an elephant were caught. Pits should be located all round the plantations on the main paths used by elephants going into them, so as to prevent as far as possible the havoc caused by the elephants in the young plantations. In wet weather, pits that have more than 3 feet of water in them should be uncovered, and if possible baled out and covered again. The present system of having pits 15 feet deep with a greater amount of padding appears to be preferable to the old system of pits 12 feet deep, since fewer animals escape, and it is possible to break the fall of the elephant more effectively with the larger quantity of padding. The necessity for having the pits sufficiently well padded with light branchwood and twigs is particularly emphasized, since there is always a tendency to put too little padding in the pits. In a 15-foot pit, the padding should, when fresh, come to within 6 feet of the top of the pit. If composed of the correct kind of materials this will be trampled down to a layer of not more than 3 feet by a captured elephant. It is essential that there should always be a large supply of new fibre ropes (sufficient for at least five captures), kept ready all through the capturing season. A great deal of time is frequently wasted by old ropes breaking, or new ropes having to be made while the elephant is in the pit. The necessity for removing elephants from the pits as quickly as possible, so as to eliminate the danger of the animals dying from straining and struggling for a long time during the capture is emphasized; arrangements must be made so that there is no unnecessary delay in this operation.

SECTION 9.—COLLECTION OF STATISTICS.

704 It is essential to start collecting statistics of the rate of growth of teak in plantations at Mount Stuart, and the effects of various grades of thinnings, and sample plots should be established in the young plantations for this purpose. The ultimate aim of these measurements is the compilation of yield tables for plantation teak at Mount Stuart.

705. Very little is known of the rate of growth of teak and other species in natural forest. The existing data are very meagre and totally insufficient for an accurate determination of the rotation, or the annual yield, and the figures for these given in this working plan are unreliable. Before the next revision of the working plan it is necessary to collect sufficient statistics for an accurate determination of the rotation and rate of increment. It is prescribed therefore that in all felling areas, ring countings on the stumps of at least 500 teak trees and other trees with distinct annual rings felled in natural forest will be made each year and recorded along with the three numbers marked on the boles before felling in the following form :—

Species.	Tree number as entered in Form 3.	Number of annual rings on stump.	Height of stump to nearest 3 inches.

It will then be possible to determine from Form 3 the breast-height girth over bark, the total length of marketable logs, and the volume outturn of each tree, and the age will be known from the ring countings.* These ring countings will take little time to do, since no diameter measurements are required. They should be carried out by a forester (either the Research Forester, or a District Forester), and at least 10 per cent of the countings should be checked by the Forest Research Officer or the District Forest Officer as the case may be. After eight or nine years of this, sufficient data will have been collected for the accurate determination of the mean annual girth increment, and the mean annual volume increment at various ages. It is essential that the ring countings be done on small as well as big trees. The average height of the stumps must be recorded, and ring countings on seedlings of known age will also have to be made in order to determine the correction in age for the height of the stump.

706. The collection of data for the compilation of Volume Tables for all saleable species by recording the breast-height girth over bark, and the outturn for every tree felled has already been prescribed in Chapter II, paragraph 424. These data are recorded in the felling register (Code Form 3). According to the present ruling of the Madras Forest Department and Account Code (Volume II, Appendix 11), timber registers, including Form 3, are to be destroyed after five years. It is essential that Form 3, which is a record containing statistics which are of cumulative value, should be recorded permanently, and steps should be taken to have the Code amended in this respect.

SECTION 10.—RECOMMENDATIONS OF THE ROYAL AGRICULTURAL COMMISSION.

707. In the Chief Conservator's Proceedings Mis. No. 439, dated 21st November 1928, it was ordered that the practical application of the recommendations of the Royal Agricultural Commission should be considered in connexion with all working plans under preparation. Since the Mount Stuart forests are primarily timber forests, and are not worked for fuel or for grazing, only the following items have any application.

708. *Chapter VIII—Recommendation No.* 38—"*The initiation of new and the development of existing forest industries.*"—The manufacture of spokes and felloes from the top ends of timber of teak and *Pterocarpus marsupium* will be continued, and increased as far as is economically possible. The possibility of establishing industries for utilizing timbers that are at present unsaleable (e.g., the manufacture of tool handles out of *Anogeissus latifolia* and *Grewia tiliæfolia* or parts of agricultural implements out of other unsaleable timbers) should be considered.

709. *Chapter VIII—Recommendation No.* 40—"*Control of shifting cultivation.*"—Certain Kadirs and Malaimalsars practise shifting cultivation in the remote parts of the Ulandi and Palakadavu blocks and in the adjoining portions of Punachi range. They have done this from time immemorial, and regard it almost as a right. They should be persuaded to come and settle in the Ulandi and Mount Stuart blocks, and to grow ponam crops with teak in parts of the Selection Felling Working Circle. No ponam should be allowed in the Clear-felling Working Circle. The ponamdars should be paid for any work done in connexion with raising the tree crop, except, of course, for the preliminary clearing of the forest which they do free of charge for the purpose of raising their field crop. The department should supply them with the necessary teak stumps and must supervise the planting work. It should be possible in this way to augment the present local labour supply, and incidentally to reduce the danger from fires started by these people, who will be more under our control than they are at present.

SECTION 11.—ANTI-MALARIAL MEASURES.

710. Anti-malarial measures will be carried out in accordance with the latest developments and theories on this subject. Hitherto at Top Slip, the surroundings of all buildings have been cleared of growth frequently during

---

* If preferred, the ring countings may be recorded in Form 3 itself.

the season to a distance of 100 yards or more. Part of this clearing has been cultivated with crops of ragi, cholam, hill paddy, and cotton, and this should be encouraged, as it saves part of the cost of clearing, and encourages local enterprise. It is not understood, however, why a heavy crop like cholam should not harbour mosquitoes as badly as Lantana or the usual mixed undergrowth that comes up on these areas, and an authoritative opinion on this point should be obtained from a malariologist. In endeavouring to eliminate the breeding places of mosquitoes round the settlement, all the streams which continue to run in the hot weather have been cleared, and paved with roughstone. This appears to be a measure of very doubtful utility since the dark-shaded holes and crannies between the stones provide ideal breeding places for the anopheles mosquitoes. Other steps taken at Top Slip are the clearing of all drains and ditches from stand pipes and the placing of bags of sawdust soaked in kerosene oil in all the ditches and streams where there is any water. These bags are renewed every month. Quinine has been administered regularly to all subordinates throughout the fever season. There is no doubt that Top Slip is a healthier station than either Mount Stuart or Anaipadi, and also that owing to the anti-malarial measures that have been taken in the last few years, it is now healthier than it was in 1926 when the station was built. There is however still great room for improvement.

711. Anti-malarial measures come under three headings, namely,—

(i) The elimination of mosquitoes from the locality.

(ii) The protection of the individual from mosquito-bites.

(iii) The eradication of infection in the human carrier by adequate treatment with quinine.

712. *The elimination of mosquitoes from the area.*—The chief measure to be taken to eliminate mosquitoes is to destroy or treat their breeding grounds. All running streams within one-quarter of a mile of Top Slip will be treated with kerosene oil by placing bags of sawdust soaked in the oil in the stream so as to block it up. These bags must be re-soaked in oil at least once a month throughout the whole of the fever season (15th December to 15th June) and more frequently if necessary. In streams that have been paved with roughstone, the holes and crannies should be filled in with chips of stone, and cemented over. The sides of streams will be cut clean and kept free from overhanging weeds that might form sheltered places for the mosquitoes to breed. All drains and ditches carrying away overflows from stand pipes or waste water from buildings will be cut on such a slope that the water runs away and does not stand in pools. Such drains and ditches will be kept clear of obstructions and overhanging growth, and will be provided with bags of sawdust soaked in kerosene. All tins and refuse in which small quantities of water may collect, will be removed and buried, and any places where there is any standing water will either be drained or treated with kerosene oil. The stumps of cut bamboos should be split so that they cannot hold water. The surroundings of buildings will be kept free of all growth for a distance of at least 100 yards. An authoritative opinion on the desirability of growing agricultural crops in anti-malarial clearings should be obtained from a competent malariologist, and if there is no objection to it, it should be encouraged.

713. *The protection of the individual from mosquito-bites.*—The anopheles mosquito does not bite during the day-time, but confines its activities to dusk and night-time. All subordinates in the range should be made to use mosquito curtains at night. They should also be encouraged not to expose themselves to the danger of being bitten after dusk, by keeping their boots and putties on until they go to bed under their mosquito nets. They should also be persuaded to smear their faces and all exposed parts of their person with kerosene oil, or better still a mixture of two parts of kerosene to one part of coconut oil. Thi mixture retains its preventive properties longer, and is pleasanter to apply than pure kerosene. The mixture should be supplied free to all men that will do this. All coolies, servants and others working in the range should be encouraged to do the same. As a preventive measure the application of oil is more

effective than taking quinine, and if one application is made just before sunset, and a second application one and a half hours later, the chances of getting fever will be very considerably reduced. All coolies and subordinates should endeavour to return from the field in good time so that they can have their food and perform their ablutions before sunset, and get to bed under their mosquito nets as soon as possible after dark.

714. The question of making the permanent quarters of the subordinates mosquito-proof, with spring gauze doors, and gauze windows should receive earnest consideration. The cost of doing so would not be excessive, and has been roughly estimated at between Rs. 150 and Rs. 250 for the ranger's bungalow. It would probably pay for itself in a very few years by the better health and the increased efficiency of the staff, besides being a humanitarian measure.

715. The use of bright lights such as the "Coleman Quiklite," "Petromax" or other lamps with incandescent mantles also greatly reduces the danger of being bitten, as the anopheles avoids bright light.

716. *Eradication of infection in the human carrier.*—Every person who has the malaria parasite in his blood is a danger to the rest of the community, since any female anopheles biting such a person can convey the infection to other persons whom it may bite. This danger is removed if all sufferers from malaria take regular doses of quinine. The local inhabitants (Kadirs and Malasars) who are all carriers of infection should always live separately in camps at least half a mile away from the subordinates' quarters, or the rest-houses. The subject of personal prophylaxis by taking quinine in regular small doses is one on which opinions differ. In the case of a person already infected the general opinion is that it probably does little to prevent recurrence of attacks, only full therapeutic doses being of any use. Anyone suffering from an attack of malaria should immediately take a full course of quinine treatment. Regarding the use of quinine as a prophylactic, it is stated that in camps where regular small doses are taken by every one, the incidence of sickness is less than in camps where no quinine is taken. This is probably due partly to the actual prophylactic effect of the quinine, and partly to the reduction of the chances of infection, since quite small doses of quinine remove the parasite completely from the peripheral blood system, making it impossible for mosquitoes biting such persons to become infected with the parasite and convey it to other persons. The ranger and foresters (when the latter are in independent charge of camps) should therefore dose all subordinates and labour with quinine regularly all through the fever season at such intervals and with such doses as are ordered by the District Forest Officer in accordance with the latest medical practice.

717. The Range Officer is responsible for the sanitation of all settlements and the health of every subordinate and coolie working in the range, and his responsibility in this respect must be very forcibly impressed upon him. The success of an anti-malarial campaign depends more upon the activity, example, and persuasion of the Range Officer than anything else, and he must see that all the measures prescribed and suggested above are efficiently and thoroughly carried out.

SECTION 12.—CONTROL.

718. The following control records will be maintained for the working circles specified against each :—

Control Book ..	Kept separately for all Working Circles.
Record of Works ..	Kept separately for the Clear-felling, Selection Felling, and Karian Shola Working Circles, and also for Miscellaneous Works.
Regeneration Ledger.	Kept separately for plantations, gap regeneration in Selection Felling Working Circle, gap regeneration in the Karian Shola Working Circle and for nursery work. Kept in detail by the Range Officers, and yearly abstracts posted in the District Forest office.
Control Journal ..	Kept for the whole forest.

Compartment History	Kept for the whole forest.	
Register of deviations from the working plan.		....
Control maps		....
Fire maps		....

719. *Control Book.*—The purpose of the Control Book is to control all exploitation by comparing the exploitation works actually carried out with those prescribed in the working plan. It is kept separately for each working circle, and only records primary exploitation work. For instance, timber extracted in the course of clear-fellings for regeneration after primary exploitation is completed, and timber extracted while clearing fire-lines is not shown, as it is not primary exploitation, but is incidental to regeneration and fire-protection works respectively. Such exploitation will not be recorded in the Control Book, but in the Record of Works. Detailed instructions for the maintenance of the Control Book are given in the respective chapters for each working circle, and specimen forms will be found in Appendix D.

720. *Record of Works.*—The Record of Works will control all works other than primary exploitation. It will be maintained separately for the Clear-felling, Selection Felling and Karian Shola Working Circles, and also for miscellaneous works, such as fire-protection, roads, buildings, etc. Each year's entries will be recorded in three separate sections, namely,—

(*a*) Works prescribed definitely.
(*b*) Works suggested but not definitely prescribed.
(*c*) Works carried out, though not prescribed or suggested.

Instructions have been given for the maintenance of this record for each working circle under the respective chapters. Where costs of regeneration work are recorded in the various Regeneration Ledgers, it is not necessary to record them again in the Record of Works, but only to record the areas regenerated and a brief description of the work done. In the record for miscellaneous work, details of the quantity and cost of each item of work will be noted. Specimen forms are given in Appendix D which indicate clearly how this record should be maintained.

721. *Regeneration Ledgers.*—These are four in number, namely, the Nursery Ledger, and the Regeneration Ledgers for the Clear-felling Working Circle, for the Selection Felling Working Circle and for the Karian Shola Working Circle. These are not control records in the strict sense of the word, inasmuch as they do not compare actual work done with work prescribed. Their purpose is to record in detail the cost of every item of work done in nursery, plantations, and gap regeneration, so that the relative merits of different methods of working may be compared,and so that the running total cost of each operation per acre (in plantations), or per gap (in gap regeneration works) can be ascertained. It is also necessary to record just precisely when any item of work is carried out. These records are essentially detailed records to be kept by the executive officer in actual charge of the works, namely, the Range Officer, and he will fill in the expenditure under each heading monthly. The record should be kept strictly up to date, and should be posted before the 10th of the month subsequent to that in which the works were carried out. A yearly abstract of the costs under each heading will be sent to the District Forest Officer in April every year, and these will be posted in a similar form in the District Forest office. Plantation and gap regeneration works carried out in the Ulandi and Palakadavu blocks should be recorded separately, and when any works are done by contractors free or for payment, the fact should be noted. The financial results of any ponam cultivation work done by contractors or hill tribes should also be noted. The records will be maintained for each plantation and area of gap regeneration, until they are established. They will then be recorded permanently in the District Forest office.

722. *Control Journal.*—The Control Journal will be kept by the District Forest Officer himself and his gazetted assistants, as laid down in the Forest Department and Account Code, section 50. It should be maintained for such of the headings given in Appendix 8 of the Code as are applicable to the Mount Stuart Forests, and in addition, information should be recorded under the following headings :—(*a*) Labour, (*b*) Elephants (which shall include capturing operations as well as maintenance and training), (*c*) Boundaries, (*d*) Conversion of timber (including results of squaring, etc.), (*e*) Quantities sold and average prices realized for each form of produce in the form of a statement, (*f*) Nursery work, (*g*) Plantations, (*h*) Gap regeneration, (*i*) Regeneration work in Karian Shola (including tending existing *Hopea* regeneration), (*j*) Other experimental works, and any other headings that the District Forest Officer may consider necessary. The purpose of the Control Journal is to record all useful and interesting observations made in the field, and items of information that are not recorded elsewhere. All entries should be signed and dated. Suggestions for the improvement of existing practice should be made freely.

723. *Compartment History.*—The purpose of the compartment history is to keep a record of all changes that take place within each permanent compartment as a result either of natural sylvicultural occurrences, or as a result of work done, so that it may be possible to see to what extent the forest is improving or degenerating under the various methods of treatment applied from time to time.

724. The form in which the compartment history will be maintained is given in Appendix E. All exploitation works undertaken in any part of a compartment or sub-compartment with the yield will be recorded, as well as all formation of plantations, thinnings (with yield), gap regeneration and any other sylvicultural operations that may have any effect upon the state of the crop. Definite natural occurrences which influence the state of the crop, such as severe fires, bamboo flowering, occurrence of abundant *Hopea* regeneration after a seed year, and similar happenings should also be recorded, but such information must be quite definite. Such remarks as " Hopea regeneration improving," or vague statements regarding the state of the crop are valueless, and should not be entered. All recorded information must be definite.

725. *Register of Deviations.*—A register of deviations from the prescriptions of the working plan shall be maintained in the following form :—

Year.	Working circle.	Prescription.	Nature of deviation.	Reasons for deviation.	Remarks on any possible action to remedy the deviation.	Number and date of order sanctioning the deviation.

726. *Control Maps and Fire Maps.*—A control map and a fire map will be maintained on blank copies of the 12-inch map, for the Mount Stuart, and Tekkadi Leased Forest blocks, and on the 4-inch Madras Forest Survey Maps for the Ulandi and Palakadavu blocks. Three copies of each will be kept, one by the Range Officer, one by the District Forest Officer and one in the Conservator's office. The Range Officer will keep his map posted up to date, entering details as they occur. Once a year he will send his map to the District Forest office (April is probably the best month, but the date should be determined by the District Forest Officer). The details on the map will be carefully checked, and any discrepancies in surveys or area computations will be enquired into and rectified, and the District Forest Officer's copy will then be posted, and the ranger's copy returned to him. If any surveys have been made by the District Forest Office draughtsman, or any details entered on the District Map which have not been put in on the ranger's copy, such omissions should be filled in before returning the ranger's copy.

727. The details that are to be put in on the control map have been described under the various working circles. Briefly summarized, they consist of the boundaries of all coupes exploited, all areas converted into plantations or

regenerated in gaps and areas thinned, with the dates of working. Distinguishing colours or marks will be used for the different operations. The length of roads constructed each year, the areas maintained as anti-malarial clearings, the positions of buildings, wells, fire-lines and any other miscellaneous works as well as all permanent sample plots in the plantations, and the boundaries of sub-compartments (when they have been constituted after working) will be accurately surveyed and located on the map.

728. Surveys must be made accurately, and the field work must be checked as far as possible by the District Forest Officer. The field books of surveyed coupes should be sent to the District Forest office for computation and plotting. They should not be computed and plotted in the range. The field books must contain sufficient reference to natural features (streams, roads, etc.), to enable the plotted surveys to be accurately placed on the maps. Small surveys may be plotted by protractor and the errors adjusted graphically, but large traverses containing more than about 25 stations are preferably computed by the method of latitudes and departures, the errors adjusted arithmetically, and the stations plotted by co-ordinates. The area should then be directly calculated from the latitudes and departures, and checked with the area of the plotted traverse as measured by planimeter. If the joining error in closed traverses is found to be too large, a resurvey should be ordered.

729. *Fire maps.*—Whenever a fire occurs, the area burnt will be entered on the separate copy of the 12-inch map kept for this purpose, or in the case of the Ulandi and Palakadavu blocks, on a neat tracing on cloth of the 4-inch map. The areas need not be surveyed, but should be put in as accurately as possible by eye. Distinctive markings should be used for the portions burnt in different years, and the area of each burnt patch should be entered on the map.

730. *Correction of maps.*—Any errors found in the present maps should be corrected. The internal boundaries between the early plantations (1919 to 1926) have been taken from surveyed sketches made by the District or Range staff, and plotted on various different scales. When reduced to the same scale, they very often did not fit each other showing a large margin of error. This was discovered at too late a stage to be rectified by the working plans staff. These boundaries should therefore be cleared and resurveyed and put in accurately on the 12-inch map. The areas of the compartments and sub-compartments concerned will have to be corrected in the compartment history.

CHAPTER VIII.—ESTABLISHMENT AND LABOUR.

SECTION 1.—ESTABLISHMENT FOR TUNACADAVU RANGE.

731. Under the working plan there will be an increase in the amount of work to be done annually. A slight reduction of work owing to the annual area of clear-felling being reduced from about 150 acres per annum to about 87 acres is more than counterbalanced by the fact that, excluding Ulandi, the quantity of timber to be extracted annually will be about 35,000 cubic feet more than it has been hitherto. The following items of work are also additional to work done in the past :—

(*a*) Fellings, instead of all being together in one place are now in three separate coupes which may be in different localities.

(*b*) Extra fellings and regeneration work in Karian Shola.

(*c*) Artificial gap regeneration in the Selection Felling Working Circle is extra.

(*d*) Demarcation and survey of coupes, clearing of compartment boundaries, etc., will be considerably more than in the past.

(*e*) An increased annual road construction programme and the construction of new buildings will entail more work.

(*f*) Thinnings in the plantations will increase every year.

(*g*) A greatly increased programme of fire-protection is prescribed.

(*h*) Nursery work is increased.

(*i*) Miscellaneous small works are extra, e.g., marking seed trees, fixing compartment boards, departmental collection of minor produce, etc.

732. The present staff of the range was just sufficient for carrying on the work under the last working plan, though a shortage was sometimes felt during the fever season in bad fever years. Under the present working plan, it is estimated that the following staff will be required.

733. *Rangers.*—One Range Officer, First Grade, and two Assistant Rangers will be required. It is essential that these should be reliable and experienced men.

734. *Foresters.*—The present staff of foresters is inadequate both in numbers and in quality. At present, of the eight foresters in the range, five are promoted Kadirs or Malsars. The latter are, in effect, little more than high-class coolies, and although they can be used for supervising labour (like forest guards), they are little used for most of the works which a forester has to do. It is essential that these Kadir and Malsar foresters be replaced by literate men from the plains who have some sense of responsibility and who can efficiently carry out the multifarious duties expected of them. If these Kadirs are replaced by literate men it is estimated that one more second-grade forester will be required. If they are not replaced at least three more good foresters will be required, as shown by the following statement :—

Foresters' grade.	Number of foresters under Mr. Wood's working plan.	Number of foresters required, if the Kadir and Malsar foresters are replaced by literate plains men.	Number of foresters required, if the Kadir and Malsar foresters are not replaced by literate men.
I	1	1	1
II	..	1	1
III	1	1	3
IV	3	3	3
V	3	3	3
Total ..	8	9	11

735. *Forest guards.*—At present there are 9 forest guards in the range, most of whom are Kadirs and Malsars. Three more guards will be required, who are competent men, and who have preferably gone through a course in the Vernacular Training School. The staff of guards will then be as follows :—

Forest Guards—

I grade	2
II grade	2
III grade	2
IV grade	6
Total..	12

736. *Other establishments.*—The following will still be required :—

One Assistant Veterinary Inspector.
One Jamadar.
One road-roller driver.
One telephone linesman.

It may be considered advisable to convert the road-roller driver and the telephone linesman into foresters so that they can be used for other works when not engaged in road or telephone works respectively. The present staff of 2 depot-keepers and 2 depot-watchers will have to be augmented by 1 extra depot-keeper and 1 extra depot-watcher when work starts at the Tekkadi end of the forest. The present office establishment consisting of one range clerk, one assistant range clerk, one temporary range clerk, one range peon, 2 tapal watchers and one peon to the Assistant Veterinary Inspector should be quite sufficient.

737. The suitability of the staff prescribed above will be tested in actual practice, and if it is found to be insufficient the District Forest Officer will put up proposals accordingly. It is emphasized that if sufficient staff is not sanctioned for carrying out all the works prescribed in this plan, the works cannot be done, and this will result in a direct loss of revenue to Government. It is therefore in the interests of the State to provide the full establishment required as soon as this plan comes into operation.

Note by the Chief Conservator.—The following establishment is considered to be sufficient and is not to be exceeded without specific sanction :—

Three rangers.
One Assistant Veterinary Inspector.
Eight foresters.
Nine forest guards.
Two depot-keepers.
One roller-driver.
One telephone linesman.
Two depot-watchers.
Two tapal watchers.

738. It is essential that there should always be at least one gazetted Assistant to the District Forest Officer.

SECTION 2.—ESTABLISHMENT FOR THE ULANDI RANGE.

739. To commence with, the staff required in the new Ulandi range will be as follows :—

One ranger.
Two foresters.
Four forest guards.
One range clerk.
Two watchers.
One range peon.

This staff should be sufficient for supervising and checking exploitation and concentrated regeneration work done by contractors, and for carrying out and tending departmental gap regeneration in the areas worked by selection fellings, as well as for fire-protection and other miscellaneous works. Later, when the regenerated areas required thinning, a larger staff may be required. This will also be the case if departmental felling and concentrated regeneration is contemplated in the event of contractors being unwilling to do the work.

Note by the Chief Conservator.—The following establishment has been sanctioned temporarily. It must not be increased without specific sanction :—

One ranger.
One forester.
Two forest guards.
One range clerk.
One tapal watcher.
One range peon.
One depot clerk.

SECTION 3.—LABOUR.

740. The present local coolie population of the Mount Stuart forests is inadequate for carrying out all the works prescribed in this plan. Every effort should be made to induce coolies to come and settle in the Mount Stuart forests, giving them land to cultivate if necessary. Such land should be given only in the selection felling working circle, and when the coolies wish to vacate a piece of land, they must leave it stocked with teak and such other timber species as the District Forest Officer may prescribe. The department should supply teak stumps for this purpose, if necessary, and should supervise the coolies who must be paid for any work done in raising the tree crop, except for the clearing of the forest for their cultivation.

741. In order to supplement the local labour force, coolies will have to be recruited from the plains. The following outside labour is available for different works :—

Type of work.	Caste or type of coolie.	Locality where available.	Number available.	Usual daily wages.	Remarks.
Felling	Axemen ..	Palghat, Mannarghat.	Large numbers.	Re. 1 ..	Usually paid on piecework.
General cutting, weeding and clearing.	Malsars ..	Sircarpatty ..	About 25 men.	10 annas.	
	Chucklers.	Anamalai, Vettaikaranputtur.	Large numbers.	10 ,,	
Road works, earthwork, etc.	Wodders.	Do.	Do.	Men—12 annas to Re. 1. Women and Boys—8 annas.	Usually paid on piecework.
Sawyers	..	Tattamangalam, Palghat.	Difficult to obtain in large numbers.	..	Paid on piecework.

742. The difficulty usually experienced in getting outside labour to come and work for long periods at Mount Stuart is to a great extent due to the bad reputation these forests have for fever. The amount of sickness among the coolies must be kept at a minimum by providing proper quarters for them to stay in, and by carrying out anti-malarial measures in all camps on the lines suggested in the previous chapter. If the coolies are treated well, and given comfortable quarters, the difficulty in obtaining outside labour will be greatly diminished.

CHAPTER IX.—FINANCIAL FORECAST AND COST OF THE PLAN.

SECTION 1.—FINANCIAL FORECAST.

743. An accurate forecast of the financial results of timber working cannot be made on account of the variability of timber prices from year to year. Reliable figures are, moreover, not available for the intermediate yields of thinnings from the plantations, and for this reason they have not been entered in the tabular statement of thinnings. It is also not known what revenue will be derived from minor forest produce and from bamboos in the next few years on account of the different method of collection of the minor produce prescribed, and the fact that the bamboos have flowered and died throughout nearly the whole of the working plan area. The following estimates of revenue are all on the conservative side, and the surplus should probably be greater than that forecasted :—

744. *Estimate of revenue for the ten years of the plan :—*

I. Clear-felling Working Circle—

1. Timber from clear-fellings—

	RS.
317,200 cubic feet of teak at Rs. 2 per cubic foot	6,34,400
32,100 cubic feet of *Dalbergia latifolia* at Rs. 1–12–0 per cubic foot	56,200
327,100 cubic feet of other saleable species at Re. 1 per cubic foot.	3,27,100

2. Timber from subsidiary fellings—

168,400 cubic feet of teak at Rs. 2–3–0 per cubic foot	3,68,400
9,000 cubic feet of *Dalbergia latifolia* at Rs. 1–14–0 per cubic foot	16,900
276,400 cubic feet of other saleable species at Re. 1–2–0 per cubic foot	3,10,900

3. Poles from thinnings—

2,000 per annum at 4 annas per pole	5,000

	RS.
II. Selection Felling Working Circle—	
(*a*) Mount Stuart Felling Series—	
Timber from selection fellings—	
101,100 cubic feet of teak at Rs. 2–3–0 per cubic foot	2,21,200
12,300 cubic feet of *Dalbergia latifolia* at Rs. 1–14–0 per cubic foot	23,100
207,300 cubic feet of other saleable species at Re. 1–2–0 per cubic foot	2,33,200
(*b*) Ulandi Felling Series—	
Selection and clear-fellings, 1,000,000 cubic feet sold standing at an average price of As. 7–6 per cubic foot	4,69,000
III. Karian Shola Working Circle—	
300,000 cubic feet at Re. 1–2–0 cubic foot	3,37,500
IV. Bamboo Working Circle—by lease of bamboo coupes at Rs. 1,200 per annum	12,000
V. Minor Produce Working Circle—	
1. By net profit on collection and sale of minor produce at Rs. 750 per annum	7,500
2. By sale of elephants, at Rs. 6,000 per annum average	60,000
VI. Miscellaneous—By manufacture of spokes and felloes 350 sets per annum at Rs. 19 per set	66,500
Total	31,48,900
Approximate annual revenue	3,14,890

(NOTE.—The rates given above for timber from selection and subsidiary fellings are the average rates realized during the last three years. The rates for timber from clear-fellings are slightly reduced on account of the larger proportion of smaller timber).

745. *Estimate of average annual expenditure during the period of the working plan*—

	RS.
I. Clear-felling Working Circle—	
1. Cost of extracting 113,020 cubic feet of timber per annum at As. 9–4·4 per cubic foot	66,153
2. Cost of formation of plantations, 84 acres on the average at Rs. 60 per acre	5,040
3. Cost of subsequent tending of plantations at Rs. 1–8–0 per acre.	126
4. Cost of thinnings, including marketing the poles, an average of 305 acres annually at Re. 1–6–0 per acre	420
II. Selection Felling Working Circle—	
(1) Mount Stuart Felling Series—	
(*a*) Extraction of timber, 32,000 cubic feet at As. 9–4·4 per cubic foot	18,736
(*b*) Gap regeneration, including weedings and subsequent tending, 160 gaps at Rs. 2–12–0 per gap	440
(2) Ulandi Felling Series—	
(*a*) Restocking failures in concentrated regeneration area—50 acres at Rs. 5 per acre	250
(*b*) Subsequent tending of concentrated regeneration areas—50 acres at Rs. 7–8–0 per acre	375
(*c*) Gap regeneration, including subsequent tending 500 gaps at Rs. 2–12–0 per gap	1,375
III. Karian Shola Working Circle—	
1. Extraction of timber 30,000 cubic feet at As. 9–4·4 per cubic foot	17,562
2. Regeneration of gaps including weedings and subsequent tending 150 gaps at Rs. 2–12–0 per gap	412
3. *Hopea* tending operations, lump-sum estimate	350

	RS.
IV. Minor Produce Working Circle—	
Elephant-capturing operations, lump sum	4,500
V. Expenditure common to all Working Circles—	
1. Annual lease amount for Tekkadi leased forest	2,500
2. Construction of cart-tracks into coupe—total length of $1\frac{1}{4}$ miles for all coupes at Rs. 900 per mile	1,100
3. Erection of temporary buildings for labour, etc.	800
4. Fire-protection	2,400
5. Maintenance of roads,—earth roads, 19 miles at Rs. 85 per mile.	1,600
6. Maintenance of metalled roads, $14\frac{1}{4}$ miles at Rs. 600 per mile ..	8,550
7. Maintenance of buildings at Rs. 600 per annum	600
8. Maintenance of telephone line	50
9. Maintenance of water-works	100
10. Anti-malarial operations	1,600
11. Maintenance of boundaries and demarcation of compartments.	150
12. Miscellaneous, including purchase of stores, tools, etc.	200
Total ..	1,35,389

VI. Interest on capital expenditure—

	Capital value.	Interest at 5 percent per annum.
	RS.	RS.
(*a*) Fixed existing capital—		
1. Permanent roads	3,37,053	16,853
2. Permanent buildings	57,866	2,893
3. Water system	13,812	691
4. Telephone line	7,473	374
5. Elephant kraals	1,573	79

(*b*) New fixed capital—	Average annual interest for the next ten years.
	RS.
1. *Permanent roads* 17 miles 7 furlongs of cart-roads to be constructed during the next nine years at a cost of Rs. 2,000 per mile interest calculated for the varying period as per road construction programme	1,100
2. Permanent roads—metalled roads	1,200
3. Permanent buildings—total cost Rs. 12,000 including Ulandi buildings mean date of construction 1934	400
Total ..	23,590

NOTE.—This includes extension of telephone line.

VII. Establishment—	
1. Two-fifths of District Forest Officer's pay and allowances ..	5,850
2. Two-fifths of gazetted assistant's pay and allowances	2,800
3. Two-fifths of District Forest office establishment's pay ..	2,800
4. Range establishment—Tunacadavu	22,000
5. Range establishment—Ulandi	5,500
Direction—(Note—this charge was allotted as Rs. 2,000 before the Chief Forest Engineer and the Saw Mills Division were abolished. Hence Rs. 1,000 is now considered to be approximately correct)	1,000
Total ..	39,950
Total over heads (interest on capital and establishment)	63,540
Total actual annual expenditure	1,35,389
Grand total ..	1,98,929
or approximately	1,99,000

746. *Note.*—In the above statement, the capital value of existing buildings was calculated as being the total original cost of the recent buildings now in use, plus half of the original cost of the old Tekkadi and Anaipadi buildings which have greatly depreciated since they were built, and which should have been written down in value. The old Mount Stuart buildings, and the Top Slip Saw Mill buildings are considered to have been written off completely, as they are not now in use.

747. Under the heading of Establishment, elephant establishment is not included, since this is already allowed for in the cost of timber production.

748. The forecasted excess of revenue over expenditure is approximately Rs. 1,16,000 per annum. It is probable however that, as better methods of regeneration and exploitation are evolved the annual expenditure will fall, and the surplus of revenue over expenditure will rise.

749. The estimated gross revenue per acre is Rs. 9·03 : the management costs are estimated at Rs. 5·71 per acre leaving a surplus of Rs. 3·32 per acre. The expenditure will be 63·2 per cent of the gross revenue.

SECTION 2.—COST OF THE WORKING PLAN.

750. The following statement gives the cost of the preparation of this working plan :—

	RS.	A.	P.
Pay of Officers—Non-voted	29,433	11	0
Pay of Officers—Voted	136	5	0
Pay of Establishment—Voted	44,925	14	6
Allowances—Non-voted—Travelling Allowances	6,876	11	0
Allowances—Voted—Travelling Allowances	9,243	15	11
Fixed Travelling Allowances	7,045	3	6
Other Compensatory Allowances	3,526	12	0
Contract Contingencies	900	15	0
Supplies and Services—Miscellaneous	65	13	0
Conservancy and Works—Working Plans	20,514	11	8
Stores, Tools and Plant	8	9	0
Total ..	1,22,678	9	7

751. The cost of the plan includes the preparation of detailed topographical maps of the whole of the Mount Stuart and Ulandi blocks, on a scale of 12-inch to a mile. They are of permanent value, so that the whole of the figure given above is not fairly debitable to the present plan.

CHAPTER X.

SUMMARY OF PRESCRIPTIONS.

I. GENERAL FACTS.

PARA.

1. *Area and distribution.*—The Mount Stuart Working Plan covers an area of 35,033 acres, comprising four contiguous blocks of forest, namely :—

	ACS.	
Mount Stuart	5,927	.. ..
Tekkadi	16,593	.. ..
Ulandi	5,476	.. ..
Palakadavu	7,037	.. ..

2. *Area of forest types.*—The total area includes—

a) 4,525 acres of unworkable forest .. ..
(*b*) 2,060 acres of evergreen forest in Mount Stuart and Tekkadi blocks ; .. ..
(*c*) 530 acres of evergreen forest in Ulandi and Palakadavu blocks ; .. ..
(*d*) 1,857 acres of teak plantations ; and .. .. ..
(*e*) 2,6061 acres of mixed deciduous forest .. .. ..

PARA.

3. *Growing stock in Mount Stuart and Tekkadi.*—In the Mount Stuart and Tekkadi blocks, teak forms 30 per cent of the growing stock, with an average stand of 117·4 cubic feet per acre ; and rosewood is 3·2 per cent of the growing stock with an average stand of 12·4 cubic feet per acre. 47 per cent of the growing stock is over 6½ feet in girth .. ..

4. *Growing stock in Ulandi and Palakadavu.*—In the Ulandi and Palakadavu blocks teak forms 16·3 per cent of the growing stock, with an average stand of 47·1 cubic feet per acre ; and rosewood is 6·5 per cent of the growing stock, with an average stand of 18·9 cubic feet per acre. 67 per cent of the growing stock is over 6½ feet in girth (vide analysis of growing stock, paragraph 539) ..

5. *Division into compartments.*—The whole area has been divided into 102 compartments, of which Nos. 1 to 80 are in the Mount Stuart and Tekkadi blocks, and the remainder in Ulandi and Palakadavu. The average area of a compartment in Mount Stuart and Tekkadi blocks, which are under intensive management, is 281 acres. In Ulandi and Palakadavu, where the management is not so intensive, the average area of a compartment is 569 acres 377

II. OBJECTS OF MANAGEMENT.

6. *The deciduous forests.*—In the deciduous forests, the object of management is, to obtain the maximum sustained income per acre as soon as possible, and to preserve the soil 367

7. *The evergreen forests.*—In the evergreen forests, the main object of management is to conserve the sources of water-supply, and to maintain the evergreen character of the forest. Consistent with this an attempt will be made to obtain the maximum return per acre from timber and other produce 368

8. *How objects will be obtained.*—It is hoped that the objects of management will be attained by working the deciduous forest intensively. Wherever suitable, the open irregular forest will be converted to regular crops of teak, rosewood and *Pterocarpus Marsupium*. In the other areas, artificial gap regeneration will be resorted to in order to improve the quality and stocking of the forest 370

III. METHODS OF TREATMENT.

9. *Area suitable for planting.*—All areas that are definitely suitable for concentrated regeneration will be clear-felled and regenerated artificially 371

10. *Other deciduous areas.*—All other workable areas in the mixed deciduous forest will be worked by selection fellings, and the gaps regenerated artificially 372

11. *Evergreen forests.*—The evergreen forests in Karian Shola will be worked by very light selection fellings of mature and overmature timber ; and an attempt will be made to regenerate gaps artificially 373

12. *Bamboos and minor produce.*—The felling of bamboos will be limited to the capacity of the forest ; and minor forest produce will be collected departmentally except in the New Ulandi range .. 374 and 375

IV. FORMATION OF WORKING CIRCLES.

13. *The five working Circles.*—There will be five working circles—
    - (*a*) The *Clear-felling Working Circle* comprises all plantations, and the areas considered suitable for planting with teak, in the Mount Stuart and Tekkadi blocks. The area is 8,689 acres.
    - (*b*) The *Selection Working Circle* comprises all workable areas of mixed deciduous forest not included in the Clear-felling Working Circle. The area is 19,760 acres.
    - (*c*) The *Karian Shola Working Circle* comprises the large block of evergreen forest to the north-west of Top Slip. The area is 2,060 acres.

PARA.

(*d*) The *Bamboo Working Circle* covers the entire deciduous forest in the Mount Stuart and Tekkadi Leased Forest Blocks.

(*e*) The *Minor Forest Produce Working Circle* covers the entire working plan area 378

V. THE CLEAR-FELLING WORKING CIRCLE.

14. *Felling Series.*—There will be two felling series :—the *Mount Stuart Felling Series* and the *Ulandi Felling Series.*

The *Ulandi Felling Series* has not been definitely allotted. It will include all areas that are clear-felled and planted in Ulandi and Palakadavu under the provisions of this Working Plan .. 385

15. *Enumeration surveys.*—The entire area has been enumerated, and details are included in the working plan 396

16. *Sub-compartments.*—For purposes of reference and control all portions of compartments allotted to different working circles will form separate sub-compartments 390

17. *Sylvicultural system.*—The Sylvicultural system will be clear-felling with concentrated artificial regeneration 402

18. *Species to be planted.*—Teak will be the primary species for artificial regeneration. The auxilliary species will be *Dalbergia latifolia* and *Pterocarpus marsupium* 400

19. *Exploitable size.*—The exploitable size aimed at for plantation-grown teak is 6 feet in girth over bark, at breast height 398

20. *The rotation.*—The rotation will be 100 years 406

21. *Periodic blocks.*—The Mount Stuart Felling Series will be divided into four, more or less equal, periodic blocks 391

22. *Average area of a periodic block.*—The average area of a periodic block will be 2,172 acres 408

23. *Area to be clear-felled annually.*—The average area to be clear-felled annually during the rotation will be 86·9 acres 408

24. *Allotment of periodic blocks.*—Only the first two periodic blocks have been allotted. The area of the first periodic block is 2,176 acres. It comprises all areas planted up to date, and 315 acres of natural forest. The area of the second periodic block is 2,172 acres .. 409

25. *Adjustment of areas in the first period.*—The 315 acres which remain to be felled in the first periodic block will be divided into four annual coupes. The average area of the first four coupes will be 79·8 acres. From the fifth year onwards the average area of a coupe will be 87·0 acres 409

26. *The yield.*—The yield is calculated by volume for the whole rotation, and is fixed at 113,000 cubic feet 416

27. *The yield.*—The yield will be obtained partly from clear-fellings, and partly from subsidiary fellings 417

28. *Regulation of the yield.*—The yield from the clear-felling will be regulated by area, approximately equal areas being felled each year. The yield from the subsidiary fellings will be regulated by volume .. .. 417 & 419

29. *Subsidiary fellings.*—The yield from the clear-felling coupes will vary greatly; and to obtain a sustained yield throughout the period of the plan, the difference between the calculated yield, and the yield from the clear-felling coupes, will be obtained by subsidiary fellings. The areas to be felled during the period of the plan have been marked on the map, and the sequence of felling has been prescribed (see statement, paragraph 523). Fellings will proceed in regular order through the prescribed compartments, all saleable timber over the girth limit being removed, until the required yield is obtained. *There must be no selection of valuable species.* The volumes of timber to be extracted must be determined from the enumerations by means of the volume tables given in Appendix F. .. .. 419 & 420

	PARA.
30. *Girth limit for subsidiary fellings.*—The girth limit for the subsidiary fellings has been fixed at 7½ feet	421
31. *Areas not to be felled.*—Subsidiary fellings will not be carried out in the areas to be clear-felled within 25 years	412
32. *Survey demarcation and marking of coupes.*—All coupes should be surveyed and demarcated in January, the year before felling; and marked for felling in February and March. The marking and enumeration must be completed by the end of July, the year previous to felling	425
33. *Marking rules.*—Marking rules are prescribed in paragraph 424. Not less than 10 per cent of the marking and measuring shall be checked by the District Forest Officer or a gazetted assistant ..	424
34. *Extraction plan.*—An extraction plan will be prepared at the time of marking	427
35. *Felling.*—Felling will commence as early as possible not later than 15th June	428
36. *Logging.*—The working plan emphasizes the importance of careful logging and prescribes how it is to be done. The advantage or otherwise of squaring will be investigated	429 to 437
37. The felling rules apply also to the subsidiary fellings	439
38. *Spokes and fellœs.*—Spokes and felloes will be made from top ends and waste timber while fellings are in progress	437
39. *Extraction.*—All saleable timber will be extracted from the coupes by the end of September. This does not apply to the subsidiary felling areas which will not be regenerated	438
40. *Clearing the felled coupes.*—The coupes will be clear-felled by 15th December and a 12-foot fire-line will be cut all round the coupe ..	440 and 441
41. *Burning.*—The area will be burnt before the end of February, whenever conditions are favourable. It is most important to obtain a good burn in the first instance. Piling and re-burning to be completed by 15th March at the latest	442
42. *Lining and staking.*—The lining and staking will be completed by the middle of April. The general espacement will be 4½ feet by 4½ feet except for certain experimental areas detailed in paragraph 476 ..	443
43. *Inspection paths.*—Inspection paths 6 feet wide will be laid out, to subdivide the area into blocks of not more than 25 acres. The paths will be constructed at the beginning of June	392 and 444
44. *Observation posts.*—Observation posts 15 feet high will be constructed at suitable points	446
45. *Seed collection.*—The District Forest Officer is responsible for devising means of ensuring that seed is only collected from suitable trees ..	447
46. *Quantity of seed required; when and how it is to be collected.*—Details are given of the quantity of seed required, and when and how it is to be collected. Teak seed will be collected in December and January, rosewood in March, and *Pterocarpus marsupium* in February and early March	449 to 456
47. *Nurseries.*—Nurseries will be required solely for growing stumps. The sites will be selected by the District Forest Officer. A nursery bed 40 feet by 4 feet is estimated to yield 1,500 stumps	457 and 458
48. *Number of beds per acre of plantation.*—Details are given of the number of nursery beds required per acre for the various methods of regeneration	459 to 461
49. *The standard method of sowing and tending in nurseries.*—The method of sowing and tending in nurseries is described fully, and will be standarized until a better method has been established. Experiments in seed treatment, and methods of raising stumps are prescribed	465 to 467
50. The standard method prescribed will produce stumps as thick as a man's finger in twelve months	468 and 469

PARA.

51. *Nursery cost.*—A statement is given showing costs for a nursery containing 300 beds. Three hundred and forty-six stumps will cost Re. 1; and the nursery costs for planting one acre 4½ feet by 4½ feet will be Rs. 6–13–0 470

52. *Nurseries for teak only.*—Only teak stumps will be raised in nurseries. *Dalbergia latifolia* and *Pterocarpus Marsupium* will be sown at stake 472

53. *Plantations; methods of formation.*—The methods prescribed are provisional. They will be adhered to until the Conservator is satisfied that one particular method is better than the others. The regeneration prescriptions will be revised in 1935 .. .. .. 473 and 381

54. *Prescriptions for first four years.*—In 1931 the whole area will be sown at stake 4½ feet by 4½ feet .. ..

In 1932, 1933, 1934 and 1935, teak will be sown at stake 4½ feet by 4½ feet in 35 acres; 30 acres will be planted with stumps 4½ feet by 4½ feet; the rest of the area will be planted with stumps 6 feet by 6 feet .. ..

55. *Stump planting* and *sowing teak stake.*—The standard practice is described in detail. It will be followed until a better method has been established. Very close supervision is necessary. Sowing of teak should be completed before the 5th of April, and stump planting before the first week in June .. .. 478 to 482

56. *Dibbling Dalbergia latifolia* and *Pterocarpus Marsupium.*—*Dalbergia latifolia* and *Pterocarpus Marsupium* will be sown at stake in the same patches as the teak (vide directions) 477

57. In the first week of June seeds will be dibbled in every patch, on the side farthest away from the teak. Ten broken pods of *Dalbergia latifolia*, and ten seeds of *Pterocarpus Marsupium* will be sown in each patch. There will be two consecutive rows of the former species to one row of the latter, ... 483

58. *Weeding.*—The guiding principles have been enunciated, and certain suggestions have been made regarding methods of weeding, scraping, soil aeration, etc., but except for the definite prescriptions noted below, details have been left to the District Forest Officer .. 484 and 485

59. *First-year tending.*—Weeds will be cut back from the middle of May, the plants being kept completely free.

To encourage a mixture, woody species will not be cut back without the District Forest Officer's orders.

Bamboo regrowth will be cut back to ground level as soon as it appears.

Lantana will be uprooted. The necessity for complete eradication of bamboo and lantana is emphasized 486

60. *Second-year tending.*—All weeds overtopping or interfering with plants, will be cut back.
Double leaders and persistent side branches will be pruned.
All damaged plants will be cut back to ground level.
Bamboo and lantana will be treated as in the first year 489

61. *Third-year tending.*—The heads of backward plants must be kept free.
Climbers and bamboos will be cut out.
Plants damaged by elephants or insects will be coppiced.

62. *Replacement of casualties.*—Details are given regarding the replacement of casualties .. .. 492 to 494

63. *Cleanings.*—Cleanings will be done after the end of the second year, as considered necessary by the District Forest Officer. Cleaning and climber cutting should be carried out two months before a thinning 495

64. *Regulation of the mixture.*—The District Forest Officer is responsible that the mixture is maintained. The proportion aimed at is 60 per cent teak, 20 per cent *Dalbergia latifolia*, 15 per cent *Pterocarpus Marsupium*, and 5 percent incidental species .. 498

PARA.

65. *Thinnings.*—It is expected that thinnings will be required in the 6th, 12th, 18th, 30th, and 50th years. The areas to be thinned each year are shown in the tabular statement of thinnings (paragraph 524). The principles governing the thinnings are laid down in the plan. At least 15 per cent of the marking for thinnings will be done by the District Forest Officer .. .. 497 to 500

66. *Exclusion of cattle.*—All the plantations are closed to grazing .. 501

67. *Cost of concentrated regeneration.*—A statement shows the cost of formation up to date. The cost per acre varies between Rs. 46–2–1 and Rs. 66–6–6. 503

68. *Experiments.*—Certain experiments are prescribed .. .. .. 504 to 506

69. *Fire-protection of plantations.*—Plantations will be protected by a 50, foot fire-line along external boundaries, and by internal fire lines 20-feet wide 507

70. *Inspection paths.*—Inspection paths 6 feet wide will be constructed in the old plantations, dividing the plantations into blocks of not more than 25 acres (Vide tabular statement, paragraph 525.) The paths will be graded and drained .. .. 509 to 511

71. *Plantation and compartment boards.*—Specifications are given for these boards 512

72. *Control.*—The following records will be maintained :—

The Control Book.
The Record of Works.
The Nursery Ledger.
The Regeneration Ledger.
The Compartment History.
The Control Maps.

Instructions are given on the maintenance of these records .. .. 513 to 522

VI. THE SELECTION WORKING CIRCLE.

73. *Area.*—The total area is 19,760 acres. 526

74. *Felling Series.*—It is divided into two Felling Series :

The Mount Stuart Felling Series (7,249 acres) and the Ulandi Felling Series (12,513·6 acres). The former lies within the Mount Stuart and Tekkadi blocks, and the latter in the Ulandi and Palakadavu blocks 532

75. The Mount Stuart Felling Series is suitable for intensive management 534

76. The Ulandi Felling Series is more inaccessible and difficult to exploit. The policy to be adopted for this series is outlined in paragraph 535 535

77. *Enumerations.*—A 100 per cent enumeration has been carried out in the Mount Stuart Felling Series, and in the Ulandi block of the Ulandi series. 17·2 per cent of the Palakadavu block has been enumerated. The results are recorded in paragraphs 537 and 539 .. .. 537 and 539

A. The Mount Stuart Felling Series.

78. *Sylvicultural system.*—The sylvicultural system will be selection felling of all saleable species over the prescribed girth limit, followed by artificial regeneration of the resulting gaps 543

79. *Species to be grown in the gaps.*—Teak will be the primary species. It will be mixed with *Dalbergia latifolia* and *Pterocarpus marsupium*. 542

80. *Exploitable size.*—The ultimate exploitable size aimed at has been fixed arbitrarily at 6½ feet in girth, over bark, at breast height .. 541

81. *Rotation.*—The rotation has been fixed at 160 years 544

82. *The felling cycle.*—The felling cycle will be 40 years. There will be four cycles in the rotation 552

PARA.

83. *The girth limit.*—On account of the excess of overmature stock the girth limit for the first felling cycle will be 7½ feet over bark at breast height. (See calculation of girth limit.) 553

84. *The yield.*—The calculated yield is 32,000 cubic feet per annum, which is 1·02 per cent of the growing stock. (See details of calculation.) This figure will serve as a basis for regulating the yield .. 545

85. *Regulation of the yield.*—The yield will be regulated by area. Coupes have been laid out by reduced areas to give equal yields : approximately 32,000 cubic feet over 7½ feet in girth, per annum 551

86. *Coupes.*—Coupes have been marked on the maps for the period of the working plan, i.e., 10 years 554

87. *Survey and demarcation of coupes.*—Coupes must be accurately surveyed and demarcated 555

88. *Marking rules.*—All trees of saleable species, 7½ feet in girth and over, will be marked for felling. The rules for numbering are the same as in the Clear-felling Working Circle (vide paragraph 424) .. 556

89. *Extraction plan.*—An extraction plan will be prepared at the time of marking 557

90. *Felling, conversion and extraction.*—The rules are the same as for the Clear-felling Working Circle. Fellings will commence as early as possible, and all timber will be extracted from the coupes by the end of September 558

91. *General policy.*—All areas felled must be fully regenerated. Gap regeneration is experimental, and after four years the result will be examined. If it is a failure the prescriptions will have to be revised. Certain suggestions are made to meet this contingency. 559

92. *Gap regeneration.*—The working plan explains the aims of artificial gap regeneration, and the objects of the measures prescribed .. 560 and 561

93. *Modus operandi.*—Full details are given in paragraphs 562 to 575. The prescriptions for this important operation cannot be effectively summarized .. .. 562 to 575

94. *Record of operations.*—The District Forest Officer will keep a record of the following facts in the Regeneration Ledger :—

(*a*) Number of trees felled and volume of timber extracted.
(*b*) Number of gaps regenerated.
(*c*) Cost and labour required for each operation.
(*d*) Number of gaps successfully stocked in March, one and two years after formation. A narrative account of the operations will be entered in the Control Journal with special reference to the objects of the measures prescribed 576

95. *The financial aspect of gap regeneration.*—It is argued that gap regeneration should be treated as part of the cost of exploiting a coupe. The regeneration of each gap is estimated to cost about Rs. 2 577

B. The Ulandi Felling Series.

96. *Object of management.*—Since facilities for extraction (the Cochin Tramway) may continue for only a limited period, the object of management is to extract the mature and overmature timber as soon as possible, and restock the area. Overfelling will be prevented by fixing a girth limit and a felling cycle 578

97. *Species to be extracted.*—Teak and *Dalbergia latifolia* are the only species that can be extracted at a resonable profit by way of the Cochin Tramway. Other species will be extracted unless a loss is incurred by doing so 580

98. *Species to be regenerated.*—Teak will be the principal species. In areas clear-felled and regenerated by contractors *Dalbergia latifolia* and *Pterocarpus marsupium* will be introduced if possible. Where gap regeneration is being done these two species will be dibbled round the periphery of the gaps 581

PARA.

99. *Sylvicultural system.*—Two distinct sylvicultural systems are prescribed :—
(1) Selection felling with artificial regeneration of the gaps.
(2) Clear-felling and concentrated regeneration in areas suitable for planting—not less than 50 acres a year 583

100. *Transfer of clear-felled areas.*—As soon as an area has been clear-felled it will be transferred to the Ulandi Felling Series of the Clear-felling Working Circle. The area to be clear-felled has not been definitely allotted 584

101. *Procedure if fellings stop.*—If felling proves impracticable the concentrated regeneration of 50 acres per annum will be continued in bamboo areas suitable for planting 585

102. *Areas not to be regenerated in gaps.*—Gap regeneration will not be done in areas likely to be clear-felled in the near future 586

103. *Exploitable size.*—Owing to the abnormally large quantity of overmature timber the girth limit for the first felling cycle is fixed at 7½ feet 579

104. *Rotation.*—The rotation will be 160 years for the Selection Working Circle, and 100 years for the Clear-felling Working Circle .. 587

105. *Felling cycle.*—The felling cycle will be 40 years 588

106. *Yield.*—The yield has not been calculated, for reasons given in paragraph 589 589

107. *Regulation of the fellings.*—No trees will be felled under 7½ feet in girth ; and no area will be worked by selection fellings more than once in a felling cycle. There are no other restrictions on the area, or quantity to be felled 589

108. *The clear-felling coupe.*—The area to be clear-felled each year will be selected by the District Forest Officer, and demarcated 590

109. *The selection coupe.*—The area to be worked by selection fellings will be chosen by the District Forest Officer. All saleable timber over 7½ feet in girth will be marked until the quantity required by the contractor is obtained. The area marked will be the coupe of the year 590

110. *Enumeration, marking and regeneration.*—These operations will be carried out as prescribed for the Mount Stuart Felling Series .. 591

111. *Concentrated regeneration.*—This will be done by the contractors. The department will supply the teak stumps, which will be planted 6 feet by 6 feet. Details are given in paragraph 594. If the contractors fail to do the work satisfactorily it will be done departmentally 594

112. *Tending, thinning and control.*—The prescriptions are the same as for the Mount Stuart Felling Series .. .. 596 to 599

VII. THE KARIAN SHOLA WORKING CIRCLE.

113. *Constitution and area.*—The working circle comprises Karian Shola, and one or two small outlying blocks of evergreen forest in the Mount Stuart and Tekkadi blocks. The area is 2,060 acres .. 601, 602 and 604

114. *Method of treatment.*—This forest is primarily protective, and its evergreen character must be maintained. It will be subjected to light experimental fellings to ascertain what species are saleable, and what species can be easily regenerated, either naturally or artificially .. .. 611 and 612

115. *Species to be extracted.*—Any saleable species, or any species for which a market might be developed, will be extracted 614

116. *Species to be regenerated.*—The species, in order of importance, are : *Hopea parviflora*, *Artocarpus hirsuta*, *Acrocarpus fraxinifolius*, *Mesua ferrea*, *Dysoxylum malabaricum* and *Cedrela toona* .. 615

117. *Sylvicultural system.*—The sylvicultural system will be very light selection fellings combined with artificial regeneration of gaps. The existing *Hopea* regeneration will be tended regularly 616

PARA.

118. *Exploitable size.*—The exploitable size has been fixed with reference to soundness. The girth limits at breast height, over bark, will be—

Mesua ferrea—6 feet.
Hopea parviflora—7 feet.
Calophyllum tomentosum—9 feet.
All other saleable species—8 feet 613

119. *Rotation.*—The rotation has been arbitrarily fixed at 150 years .. 617

120. *Felling cycle.*—The felling cycle will be 25 years 618

121. *Coupes.*—Coupes have been marked on the map for the period of the working plan. The average area of a coupe will be 82·4 acres 618

122. *The yield.*—The yield has not been calculated. A rough forecast estimates the outturn at approximately 30,000 cubic feet .. 619 and 620

123. *Marking for felling.*—The marking will be done by a specially trained ranger. His work will be checked by the District Forest Officer or a gazetted assistant.. 622

124. *Marking rules.*—No two trees shall be marked within 20 yards of each other, and the total number marked shall not exceed three per acre. Other rules are detailed in paragraph 624 624

125. *Felling, logging and extraction.*—The general rules are the same as for the Clear Felling Working Circle. All timber will be extracted from the coupe before the end of February .. .. 625 and 626

126. *Seed collection.*—Seed will be collected only from well-shaped vigorous trees. Short notes are included on the seeding of the chief species .. .. 627 to 631

127. *Nursery.*—A small permanent nursery will be maintained. A nursery containing 35 beds each 40 feet by 4 feet estimated to produce 35,000 seedlings of all species annually .. .. .. 632 and 633

128. *Artificial gap regeneration.*—Full details are given in the Working Plan. This important operation cannot be effectively summarized. 634 to 640

129. *Strobilanthes.*—It is suggested that *Strobilanthes* should be cut back after flowering and before seeding in the neighbourhood of all gaps 642

130. *Thinnings of gap regeneration.*—This will be considered at the next revision of the working plan 643

131. *Hopea tending.*—*Hopea* regeneration will be tended according to a regular programme (see tabular statement, paragraph 650). Full instructions are given. The operation is estimated to cost Rs. 1-8-0 per acre of such regeneration .. .. 644 and 645

132. *Climber cutting.*—Climbers will be cut when the coupes are being marked 646

133. *Control.*—The following control records will be maintained separately for this Working Circle—

The Control Book.
The Record of works.
The Regeneration Ledger.

Details are given of the entries to be made on the control map .. 647 and 648

VIII. The Bamboo Working Circle.

134. *Constitution.*—The Bamboo Working Circle is confined to the Mount Stuart and Tekkadi blocks 651

135. *Method of treatment.*—Between 1926 and 1930 bamboo seeded and died throughout the Mount Stuart Forests. This fact influences the method of treatment. For the first five years the whole working circle will be sold annually. In the fourth year a fresh scheme will be prepared prescribing annual coupes and a suitable felling cycle 653

PARA.

136. *Method of executing the fellings.*—(*a*) There will be no felling restrictions for clumps that have flowered.

(*b*) In newly formed clumps at least five culms will be left, and no culm under two years old will be felled.

(*c*) High cutting will be permitted.

(*d*) The contractor will be held responsible for damage done by him in areas under regeneration .. .. 654 to 656

137. *Control.*—The area of each coupe, the number of bamboos extracted and the price realized will be posted in the control book (see specimen form in Appendix D-3) 657

IX. THE MINOR PRODUCE WORKING CIRCLE.

138. *Constitution.*—The minor Produce Working Circle covers the whole working plan area 658

139. *Method of working.*—In order to control forest fires and to obtain information, all minor produce will be collected departmentally except in the new Ulandi Range. The area will be leased to contractors but the ranger will be responsible for the collection of the produce (see detailed prescriptions) 659

140. *Control.*—A special Control Book will be maintained for this working circle. The results of elephant catching operations will be entered in this book. (Vide Appendix D-4.) 661

X. MISCELLANEOUS REGULATIONS.

141. *Safeguards against over-production.*—(*a*) Carting logs to Pollachi will cease when the stock in the depot reaches 100,000 cubic feet.

(*b*) No logs shall remain unsold in the Pollachi depot for more than two years.

(*c*) All felled timber must be carted from the forest before the end of the financial year subsequent to the year of felling.

(*d*) All felling will cease as soon as there is any such uncarted timber. 662 and 663

142. *Restriction of fellings.*—If fellings are to be restricted, the subsidiary fellings will be stopped first, and then the selection fellings in the Mount Stuart Series 664

143. *Roads.*—A complete road system covering 46 miles has been drawn up, of which 31 miles have still to be constructed. The system will be completed before the end of the first felling cycle. All roads constructed and proposed have been shown on the maps. A tabular statement (paragraph 671) gives details of the roads to be constructed during the period of the plan .. .. 662 to 668 and 671

144. *Road specifications.*—Brief specifications are given in paragraph 669 and 670. .. .. 669 and 670.

145. *Cost of road system.*—The earth roads will cost not more than Rs. 2,000 per mile; and the cost of the entire road system will be about Rs. 40,000. The Ayyasamimudi ghat road is roughly estimated at Rs. 35,000. The unit cost of the road system is 5 pies per cubic foot 672

146. *Maintenance of roads.*—The Working Plan emphasizes the necessity of proper maintenance 673

147. *Bridle paths.*—A bridle path with a maximum gradient of 1 in 5, passable for baggage elephants, will be constructed from Top Slip to Tekkadi through Karian Shola 674

148. *Telephone extensions.*—The telephone line will be extended to Sungam and Tekkadi 675

149. *Buildings.*—A new serambi will be constructed between Sungam and Tellikal. The Tekkadi rest-house and quarters will be repaired. A kitchen will be added to the ranger's quarters at Tekkadi. Quarters will be constructed at Tekkadi for two Foresters, and one Depot-keeper; and lines will be built to accommodate 60 to 100 coolies. The Tekkadi buildings must be taken in hand immediately .. .. 676 and 677

PARA.

150. *Fire-protection.*—Complete protection against fire is of the utmost importance. The Fire-protection scheme includes—
(*a*) Protection of the outer boundary against invading fires.
(*b*) Internal protection of all artificially regenerated areas.
(*c*) Prevention by indirect methods such as the departmental collection of minor produce, the payment of rewards to the resident natives, and the adoption of punitive measures if necessary. Complete details are given in the working plan .. 680 to 699

151. *Cost of fire-protection.*—Fire-protection is estimated to cost Rs. 2,300 per annum 700

152. *Livestock.*—Elephants will be maintained for timber extraction. The present numbers will suffice. Dragging should be reduced by making cart-tracks into the coupes 701

153. *Elephant capturing.*—Elephant capturing operations will be continued on the same lines as at present 703

154. *Collection of statistics.*—Statistics will be collected to provide data for the compilation of volume and yield tables .. .. .. 704 to 706

155. *Recommendations of the Royal Agricultural Commission.*—The only two recommendations which apply to these forests are No. 38 :—" The initiation of new, and the development of existing forest industries," and No. 40—" Control of shifting cultivation." These have been duly considered .. .. 707 to 709

156. *Anti-malarial measures.*—The working plan summarizes the aetiology of malaria, and prescribes certain prophylactic measures .. .. 710 to 717

157. *Control.*—The following Control records will be maintained.—
The Record of Works.
The Control Book.
The Regeneration Ledger.
The Control Journal.
The Compartment History.
The Register of Deviations.
Control Maps.
Fire Maps.

Detailed instructions are given on the maintenance of these records .. .. 718 to 730

158. *Establishment.*—A small increase in staff will be necessary to carry out the prescriptions of the working plan. The staff required is mentioned in paragraphs 731 to 739 .. .. 731 to 739

159. *Financial forecast.*—The estimated gross revenue is Rs. 3,22,860 and the estimated expenditure is Rs. 1,98,825, leaving a surplus of Rs. 124,000 approximately. This is equivalent to Rs. 3·56 per acre. The expenditure will be 61·6 per cent of the gross revenue. 743 to 749

160. *Cost of the working plan.*—The total cost of the working plan is Rs. 122,678-9-7 .. .. 750 and 751

APPENDIX A.

Analysis of Growing Stock over 3 feet in girth, Mount Stuart, 1930.

Analysis of Growing Stock over 3 feet in girth, Mount Stuart, 1930.

Compartment No.	Area in acres.						Volume of saleable				
	Clear Felling W.C.	Selection W,C.	Ever green W.C.	Plantation.	Unworkable.	Total.	Clear-felling				
							Teak.				
							3′—6½′.	6½′—7½′.	Over 7½′.	Total.	3′—6½′.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1 ..	95·73	89·16	..	..	28·36	213·25	8,296	2,404	4,221	14,921	745
2 ..	78·67	143·02	..	..	..	221·69	2,842	2,135	3,398	8,375	966
3 ..	..	254·22	..	..	..	254·22	..	..	..	..	..
4 ..	..	243·74	..	..	46·84	290·58	..	..	..	..	..
5 ..	..	140·53	..	..	274·38	414·91	..	..	..	..	..
6 ..	124·08	139·73	..	..	82·50	346·31	2,370	1,978	4,158	8,506	1,095
7 ..	169·42	111·47	..	..	18·22	299·11	3,819	2,095	6,937	12,851	2,618
8 ..	49·96	63·82	7·82	..	248·09	369·69	709	659	1,064	2,432	785
9 ..	182·84	124·36	..	..	..	307·20	4,346	3,001	5,574	12,921	1,579
10 ..	49·96	118·29	49·61	..	2·49	220·35	838	370	1,508	2,716	531
11 ..	112·35	123·56	..	..	..	235·91	2,150	1,364	2,766	6,280	963
12 ..	112·63	68·54	..	..	..	181·17	7,905	4,197	10,465	22,567	1,008
13 ..	84·63	205·94	..	..	..	290·57	6,420	2,979	5,572	14,971	617
14 ..	189·24	164·01	18·76	..	..	372·01	11,756	6,096	9,497	27,349	2,115
15 ..	60·89	211·55	108·71	..	..	381·15	1,829	663	1,724	4,216	831
16 ..	109·69	145·78	..	..	..	255·47	16,031	8,065	12,652	36,738	1,461
17 ..	207·31	141·47	..	..	..	348·78	17,344	10,792	12,221	40,357	2,081
18 ..	115·65	79·55	..	..	..	195·20	19,165	9,658	18,715	47,538	1,472
19 ..	202·19	79·14	..	..	..	281·33	27,343	17,488	36,305	81,136	2,080
20 ..	273·95	64·14	..	..	..	338·49	35,870	28,526	57,526	121,922	2,403
21 ..	196·62	58·40	..	..	..	255·02	11,128	10,312	42,785	64,225	2,438
22 ..	184·29	53·31	..	..	..	237·60	16,608	15,597	45,667	77,872	2,242
23 ..	229·25	83·55	..	..	..	312·80	28,316	24,073	46,355	98,744	2,439
24 ..	128·72	53·78	..	..	..	182·50	14,832	13,667	20,190	48,689	2,085
25 ..	101·42	109·78	..	..	..	211·20	14,393	8,020	9,510	31,923	1,127
26 ..	222·05	58·22	..	..	..	280·27	27,432	14,778	22,681	64,891	2,922
27 ..	237·69	55·46	..	..	..	293·15	16,754	16,799	58,549	92,102	4,019
28 ..	191·30	82·65	..	..	..	273·95	23,874	15,705	31,669	71,248	1,900
29 ..	155·40	80·69	..	2·22	..	238·31	14,647	8,713	16,225	39,585	2,443
30 ..	143·56	124·44	..	..	..	268·00	16,186	10,243	23,933	50,362	1,942
31 ..	344·45	54·57	..	..	..	399·02	43,197	32,237	64,453	139,887	4,395
32 ..	259·82	55·29	..	..	..	315·11	29,373	18,245	40,852	88,470	5,625
33 ..	122·29	96·80	..	..	38·06	257·15	3,521	3,183	18,316	25,020	2,005
34 ..	135·46	116·44	..	..	104·36	356·26	12,287	9,310	25,100	46,697	1,872
35 ..	97·91	36·66	..	..	163·83	298·40	7,913	4,556	7,939	20,408	1,202
36 ..	110·58	40·71	..	..	190·93	342·22	14,954	7,854	12,583	35,391	1,645
37 ..	192·43	99·93	..	..	333·69	626·05	29,647	14,752	31,186	75,585	2,454
38 ..	206·31	87·56	..	10·13	..	304·00	18,921	8,559	6,188	33,668	2,106
39 ..	212·43	11·64	..	165·70	..	389·77	43,053	16,242	21,311	80,606	3,109
40 ..	188·28	13·78	..	17·58	..	219·64	17,952	9,512	13,600	41,064	2,585
41 ..	320·62	126·75	..	4·36	..	451·73	25,329	14,503	16,340	56,172	3,067
42 ..	3·91	4·62	..	137·96	..	146·49	..	..	..	..	16
43 ..	23·28	..	..	506·85	..	530·13	1,851	1,300	2,329	5,480	289
44 ..	..	0·98	0·44	254·84	..	256·26	..	..	..	..	..
45 ..	104·09	219·82	25·42	8·00	..	357·33	6,669	1,319	2,309	10,297	828
46 ..	107·64	198·76	..	..	..	306·40	14,380	2,732	1,210	18,322	1,167
47 ..	22·94	213·86	..	..	..	236·80	2,371	66	34	2,471	237
48 ..	..	100·06	..	5·00	..	105·06	1,759	1,039	1,689	4,487	249
49 ..	23·73	193·08	30·75	..	..	247·56	610	169	168	947	119
50 ..	..	113·37	133·68	..	..	247·55	..	..	..	..	..
51 ..	0·62	246·40	72·00	..	..	319·02	..	..	..	..	..
52 ..	16·44	59·12	..	..	216·71	292·27	3,227	2,855	5,684	11,766	95
53 ..	102·14	40·36	..	103·99	..	246·49	13,880	7,621	13,994	35,495	739
54 ..	..	..	263·47	..	..	263·47	..	..	..	..	..
55 ..	..	..	195·29	..	26·93	222·22	..	..	..	..	..
56 ..	..	..	227·38	..	..	227·38	..	..	..	..	..
57 ..	..	..	184·00	..	216·89	400·89	..	..	..	..	..
58 ..	..	54·22	121·50	..	29·26	204·98	..	..	..	..	..
59 ..	..	163·11	25·24	..	174·04	362·39	..	..	..	..	..
60 ..	..	..	206·58	..	..	206·58	..	..	..	..	..
61 ..	..	89·00	54·31	75·53	..	218·84	..	..	..	..	..
62 ..	..	63·91	20·80	70·84	..	155·55	..	..	..	..	..
63 ..	..	24·80	200·18	..	..	224·98	..	..	..	..	..
64 ..	..	216·18	..	29·78	16·98	262·94	..	..	..	..	..
65 ..	1·87	185·25	..	41·15	10·84	239·11	..	..	..	..	..
66 ..	79·20	125·15	21·25	17·60	..	243·20	306	322	..	628	597
67 ..	..	58·49	88·69	..	..	147·18	..	..	..	..	..
68 ..	48·80	85·34	3·73	1·42	..	139·19	1,895	428	..	2,323	273
69 ..	..	85·07	..	67·82	..	152·89	..	..	..	..	..
70 ..	..	120·27	..	2·89	60·80	183·96	..	..		..	..
71 ..	..	105·07	..	54·31	44·70	204·08	..	..	..	..	..
72 ..	..	59·73	..	122·40	..	182·13	..	..	..	..	..
73 ..	..	135·46	..	81·51	..	216·97	..	..	..	..	..
74 ..	80·97	0·36	..	..	153·87	235·20	11,668	6,370	15,303	33,341	542
75 ..	16·49	48·36	..	75·29	230·76	370·90	1,336	576	2,403	4,315	33
76 ..	..	16·62	..	..	131·38	148·00	..	..	..	..	..
77 ..	..	4·88	..	..	246·12	251·00	..	..	..	..	..
78 ..		1·20	..	..	221·40	222·60	..	..	..	..	..
79 ..	..	..	..	..	498·30	498·30	..	..	..	..	..
80 ..	..	..	..	..	714·40	714·40	..	..	..	..	..
Total ..	6,832·19	7,246·23	2,059·61	1,857·17	4,525·13	22,520·36	659,302	404,117	814,858	1,878,277	82,156

Timber in cubic feet.

Working Circle.								Selection Working Circle.			
Rose wood.			Other saleable species.				Total.	Teak			
6½′—7½′. (13)	Over 7½′. (14)	Total. (15)	3′—6½′. (16)	6½′—7½′. (17)	Over 7½′. (18)	Total. (19)	(20)	3′—6½′. (21)	6½′—7½′. (22)	Over 7½′. (23)	Total. (24)
43	362	1,150	13,489	700	1,919	16,108	32,179	3,070	651	267	3,988
102	194	1,262	12,660	2,202	4,484	19,346	28,983	6,437	3,077	4,375	13,889
..	..	..	..	..	..	..	..	7,478	3,657	6,486	17,621
..	..	..	..	..	..	..	..	13,666	5,099	9,320	28,085
..	..	..	..	..	..	..	..	13,157	5,998	14,942	34,097
457	310	1,853	16,577	4,434	13,593	34,604	44,963	11,600	4,197	11,275	27,072
635	1,146	4,399	47,327	14.198	35,842	97,367	114,617	5,269	2,003	6,987	14,259
239	627	1,651	19,715	8,379	7,219	35,313	39,396	990	256	539	1,785
454	543	2,576	45,265	15,381	30,403	91,049	106,546	2,350	797	1,130	4,277
243	90	864	17,331	4,294	7,627	29,252	32,832	23	71	77	171
216	200	1,379	28,177	6,060	13,786	48,023	55,682	2,127	1,387	1,521	5,035
..	117	1,125	28,671	7,409	15,105	51,185	74,877	2,723	1,850	2,700	7,273
252	476	1,345	34,977	4,059	5,871	44,907	61,223	9,207	1,897	2,694	13,798
1,160	426	3,701	56,882	10,702	10,516	78,100	109,150	9,771	4,163	7,652	21,586
174	444	1,449	12,518	4,120	6,725	25,363	31,028	601	525	1,423	2,549
397	351	2,209	40,308	12,467	12,753	65,528	104,475	17,926	7,363	13,183	38,472
272	214	2,567	58,843	13,487	21,404	93,734	136,658	5,986	2,461	3,860	12,307
53	582	2,107	47,930	14,988	17,669	80,587	130,232	8,486	3,121	6,150	17,757
119	391	2,590	78,711	21,996	27,619	128,326	212,052	6,461	3,335	6,190	15,986
705	1,207	4,315	119,212	32,898	63,976	216,086	342,323	1,733	1,353	2,692	5,778
774	4,174	7,386	89,394	30,637	77,067	197,098	268,709	368	294	2,657	3,319
1,082	2,896	6,220	71,137	25,660	50,873	147,670	231,762	622	485	700	1,807
903	978	4,320	83,384	19,776	37,948	141,108	244,172	10,427	5,636	10,643	26,706
653	492	3,230	52,183	16,765	33,815	102,763	154,682	3,447	2,283	2,928	8,658
76	215	1,418	32,679	6,705	10,911	50,295	83,636	9,603	3,935	6,966	20,504
796	1,092	4,810	87,068	20,663	18,357	126,128	195,829	6,134	1,861	4,105	12,100
1,132	2,964	8,115	90,836	38,071	83,721	212,628	312,845	3,151	2,033	6,047	11,231
982	2,160	5,042	68,742	18,584	24,593	111.879	188,169	7,436	4,389	7,905	19,730
1,212	912	4,567	52,587	12,942	17,395	82,924	127,076	3,510	1,374	2,534	7,418
271	624	2,837	57,137	16,079	26,694	99,910	153,109	17,036	9,843	17,245	44,124
1,628	2,019	8,042	105,562	24,225	35,282	165,069	312,998	4,409	2,224	6,185	12,818
1,833	1,863	9,321	78,608	21,313	30,840	130,761	228,552	2,992	3,273	5,127	11,392
785	2,500	5,290	34,798	15,016	28,099	77,913	108,223	696	485	2,031	3,212
934	1,067	3,873	42,236	16,031	33,583	91,850	142,420	2,325	1,514	7,127	10,966
145	375	1,722	26,687	6,824	9,091	42,602	64,732	2,848	1,307	1,011	5,166
489	1,269	3,403	28,068	10,118	18,980	57,166	95,960	691	126	402	1,219
1,607	3,173	7,234	45,260	17,045	33,344	95,649	178,468	3,977	2,390	4,401	10,768
561	460	3,127	48,177	11,044	13,637	72,858	109,653	3,627	1,558	744	5,929
639	443	4,191	53,916	14,308	12,307	80,531	165,328	350	..	..	350
394	75	3,054	35,627	11,984	16,790	64,401	108,519	1,477	488	651	2,616
622	352	4,041	76,090	19,494	25,357	120,941	181,154	8,086	3,067	2,558	13,711
..	..	16	278	190	71	539	555	..	..	..	..
32	214	535	6,350	1,830	2,753	10,933	16,948	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
53	136	1,017	14,106	1,229	2,326	17,661	28,975	6,008	946	1,462	8,416
316	71	1,554	22,408	2,908	1,730	27,046	46,922	18,686	4,265	1,867	24,818
..	71	308	3,252	273	275	3,800	6,579	15,923	1,541	485	17,949
..	..	249	3,894	1,449	2,467	7,810	12,546	12,920	5,472	7,131	25,523
..	..	119	2,519	878	374	3,771	4,837	11,740	1,947	1,688	15,375
..	..	..	..	..	..	..	..	5,759	883	453	7,095
..	..	..	..	..	..	..	..	3,122	888	1,224	5,234
47	521	663	2,468	1,408	1,052	4,928	17,357	1,861	1,265	3,126	6,252
134	494	1,367	11,722	5,190	6,790	23,702	60,564	3,953	1,467	1,589	7,009
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	284	291	574	1,149
..	..	..	..	..	..	..	..	2,744	1,476	7,497	11,717
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	3,178	276	437	3,891
..	..	..	..	..	..	..	..	676	60	..	736
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	11,097	1,245	1,081	13,423
..	..	..	..	..	..	..	..	4,603	1,142	448	6,193
196	58	851	9,981	2,026	4,393	16,400	17,879	333	..	..	333
..	..	..	..	..	..	..	..	734	192	134	1,060
136	..	409	4,710	1,136	478	6,324	9,056	1,269	382	93	1,744
..	..	..	..	..	..	..	..	6,503	2,461	1,761	10,725
..	..	..	..	..	..	..	..	2,201	758	1,797	4,756
..	..	..	..	..	..	..	..	8,671	3,219	6,077	17,967
..	..	..	..	..	..	..	..	2,820	1,680	680	5,180
..	..	..	..	..	..	..	..	11,065	2,710	2,163	15,938
200	1,670	2,412	12,421	6,692	10,072	29,185	64,938	48	384	771	1,203
64	287	384	2,539	1,210	1,833	5,582	10,281	3,847	1,592	2,143	7,582
..	..	..	..	..	..	..	..	..	..	..	..
..	..		..	..	..	..	..	..	..	..	..
..	..		..	..	..	..	..	119	43	93	255
..	..		..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
24,217	41,296	1,47,669	2,037,377	577,477	969,849	3,584,703	5,610,649	362,437	138,411	240,204	741,052

Volume of saleable

	Selection Working Circle,								Total.	Evergreen W.C.	Total 3′—6½ .
	Rosewood.				Other saleable species,			Total.			
	3′—6½′.	6½′—7½′.	Over 7½′.	Total.	3′—6½′.	6½′—7½′.	Over 7½′.				
	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)
1 ..	995	164	194	1,353	10,156	1,147	2,385	13,688	19,029	..	36,751
2 ..	1,629	281	239	2,149	17,935	5,375	9,682	32,992	49,030	..	42,469
3 ..	1,643	410	306	2,359	29,148	8,568	20,553	58,269	78,249	..	38,269
4 ..	2,509	948	785	4,242	46,388	10,771	21,229	78,388	110,715	..	62,563
5 ..	1,478	608	1,337	3,423	42,096	8,229	15,031	65,356	102,876	..	56,731
6 ..	850	604	516	1,970	30,292	8,681	16,960	55,933	84,975	..	62,784
7 ..	1,405	327	505	2,237	18,852	6,696	14,958	40,506	57,002	..	79,290
8 ..	702	986	606	2,294	16,320	5,648	7,302	29,270	33,349	..	39,221
9 ..	1,127	229	978	2,334	30,406	8,194	11,760	50,360	56,971	..	85,073
10 ..	696	484	698	1,878	25,162	6,478	8,088	39,728	41,777	..	44,581
11 ..	1,536	280	103	1,919	27,623	8,273	17,272	53,168	60,122	..	62,576
12 ..	521	146	..	667	16,954	3,659	6,179	26,792	34,732	..	57 782
13 ..	2,736	428	679	3,843	52,205	5,349	5,204	62,758	80,399	..	106,162
14 ..	1,622	324	752	2,698	51,816	10,909	9,953	72,678	96,962	..	133,962
15 ..	815	613	1,234	2,662	33,916	5,929	9,320	49,165	54,376	..	52,510
16 ..	2,103	202	..	2,305	55,414	14,106	14,215	83,735	124,512	..	133,243
17 ..	1,287	489	231	2,007	32,274	3,308	5,563	41,145	55,459	..	117,815
18 ..	709	34	173	916	22,469	4,745	3,863	31,077	49,750	..	100,231
19 ..	967	161	371	1,499	28,842	7,384	7,391	43,617	61,102	..	144,404
20 ..	1,149	356	271	1,776	25,500	6,975	14,160	46,635	54,189	..	185,867
21 ..	1,467	693	1,505	3,665	17,879	5,705	18,065	41,649	48,633	..	122,674
22 ..	2,082	842	1,169	4,093	12,402	5,816	14,949	33,167	39,067	..	105,093
23 ..	1,859	582	404	2,845	23,821	6,191	11,747	41,759	71,310	..	150,246
24 ..	1,683	605	747	3,035	17,587	5,209	8,053	30,849	42,542	..	91,817
25 ..	2,912	847	742	4,501	26,301	6,118	10,005	42,424	67,429	..	87,015
26 ..	394	72	..	466	20,380	4,074	4,955	29,409	41,975	..	144,330
27 ..	1,039	273	1,023	2,335	11,644	4,139	11,485	27,268	40,834	..	127,443
28 ..	1,485	583	495	2,563	19,846	4,808	7,216	31,870	54,163	..	123,243
29 ..	2,053	682	663	3,398	19,781	6,177	6,817	32,775	43,591	..	95,021
30 ..	1,188	411	291	1,890	41,132	8,954	13,008	63,094	109,108	..	134,621
31 ..	948	340	519	1,807	11,106	3,241	4,182	18,529	33,154	..	169,617
32 ..	973	607	365	1,945	11,785	3,383	2,797	17,965	31,302	..	129,356
33 ..	1,795	465	1,731	3,991	30,864	10,970	29,578	71,412	78,615	..	73,679
34 ..	995	1,082	1,212	3,289	19,746	9,124	17,493	46,363	60,618	..	79,461
35 ..	843	60	636	1,539	8,513	2,306	3,479	14,298	21,003	..	48,006
36 ..	294	192	921	1,407	8,862	2,038	5,084	15,984	18,610	..	54,514
37 ..	1,109	385	1,335	2,829	17,311	9,433	16,817	43,561	57,158	..	99,758
38 ..	857	155	158	1,170	23,748	4,507	4,428	32,683	39,782	..	97,436
39 ..	60	53	..	113	2,429	168	497	3,094	3,557	..	102,917
40 ..	123	..	..	123	2,484	401	211	3,096	5,835	..	60,248
41 ..	1,202	76	..	1,278	23,975	5,716	7,371	37,062	52,051	..	137,749
42 ..	..	..	..	..	..	..	..	..	..	..	294
43 ..	..	..	..	..	..	..	..	..	..	..	8,490
44 ..	..	..	..	..	..	..	..	..	..	..	..
45 ..	2,016	239	87	2,342	25,037	3,217	5,190	33,444	44,202	..	54,664
46 ..	1,515	237	48	1,800	39,875	4,754	2,786	47,415	74,033	..	98,031
47 ..	2,326	254	163	2,743	47,202	4,180	1,593	52,975	73,667	..	71,311
48 ..	1,382	185	..	1,567	33,459	9,249	7,606	50,314	77,404	..	53,663
49 ..	1,520	270	136	1,926	32,571	4,270	2,568	39,409	56,710	..	49,079
50 ..	913	372	399	1,684	19,434	3,026	2,790	25,250	34,029	..	26,106
51 ..	1,621	754	655	3,030	30,857	7,387	10,434	48,678	56,942	..	35,600
52 ..	356	331	1,766	2,453	8,829	3,492	7,199	19,520	28,225	..	16,836
53 ..	429	53	..	482	7,823	2,388	2,873	13,084	20,575	..	38,546
54 ..	..	..	..	..	..	..	..	..	..	..	..
55 ..	..	..	..	..	..	..	..	..	..	..	..
56 ..	..	..	..	..	..	..	..	..	..	..	..
57 ..	..	..	..	..	..	..	..	..	..	..	..
58 ..	285	37	826	1,148	9,216	1,615	2,678	13,509	15,806	..	9,785
59 ..	1,151	358	934	2,443	19,042	4,308	7,369	30,719	44,879	..	22,937
60 ..	..	..	..	..	..	..	..	..	..	..	..
61 ..	363	142	..	505	8,565	731	2,374	11,670	16,066	..	12,106
62 ..	36	..	..	36	1,767	369	161	2,297	3,069	..	2,479
63	Bamboo and Grass—No tree growth			..	..	..	..	..	..	..	..
64 ..	983	88	71	1,142	19,062	1,712	1,656	22,430	36,995	..	31,142
65 ..	1,339	242	423	2,004	17,729	3,509	3,242	24,480	32,677	..	23,671
66 ..	743	377	265	1,385	10,378	2,413	2 781	15,572	17,290	..	22,338
67 ..	504	96	15	615	4,338	790	998	6,126	7,801	..	5,576
68 ..	491	221	56	768	4,557	1,223	822	6,602	9,114	..	13,195
69 ..	427	174	600	1,201	12,048	2,723	4,851	19,622	31,548	..	18,978
70 ..	1,006	519	1,050	2,575	13,296	2,256	3,569	19,121	26,452	..	16,503
71 ..	373	103	490	966	15,837	3,950	6,506	26,293	45,226	..	24,881
72 ..	179	..	58	237	6,041	1,568	2,087	9,696	15,113	..	9,040
73 ..	985	222	..	1,207	15,359	3,499	309	21,954	39,099	..	27,409
74 ..	57	..	309	366	726	119	208	1,053	2,622	..	25,462
75 ..	394	197	862	1,453	9,133	4,061	6,677	19,871	28,906	..	17,282
76 ..	19	47	181	247	2,041	781	2,305	5,127	5,374	..	2,060
77 ..	..	..	..	..	..	..	..	..	..	..	..
78 ..	133	60	97	290	590	685	420	1,695	2,240	..	842
79 ..	..	..	..	..	..	..	..	..	..	..	..
80 ..	..	..	..	..	..	..	..	..	..	..	..
Total ..	73,386	22,657	33,385	129,428	1,400,176	327,177	514,144	2,214,497	3,111,977	..	4,614,834

Timber in cubic feet.			Abstract.								
Total 6½′—7½′.	Total over 7½′.	Grand total.	Teak.			Rosewood.			Miscellaneous.		
			Total quantity.	Percentage.	Volume per acre.	Total quantity.	Percent-age.	Volume per acre.	Total quantity.	Percentage.	Volume, per acre.
(36)	(37)	(38)	(39)	(40)	(41)	(42)	(43)	(44)	(45)	(46)	(47)
5,109	9,348	51,208	18,909	37	88	2,503	5	11	29,796	58	135
13,172	22,372	78,013	22,264	29	100	3,411	5	15	52,338	66	237
12,635	27,345	78,249	17,621	23	69	2,359	3	9	58,269	74	229
16,818	31,334	110,715	28,085	25	97	4,242	4	15	78,388	71	270
14,835	31,310	102,876	34,097	33	82	3,423	3	8	65,356	64	158
20,351	46,803	129,938	35,578	28	103	3,823	3	11	90,537	69	206
25,954	66,375	171,619	27,110	16	90	6,636	4	22	137,873	80	461
16,167	17,357	72,745	4,217	6	12	3,945	6	11	64,583	88	175
28,056	50,388	163,517	17,198	11	56	4,910	3	11	141,409	86	461
11,940	18,088	74,609	2,887	4	13	2,742	3	12	68,980	93	314
17,580	35,648	115,804	11,315	11	48	3,298	3	14	101,191	86	429
17,261	34,566	109,609	29,840	27	164	1,792	2	9	77,977	71	431
14,964	20,496	141,622	28,769	20	99	5,188	4	18	107,665	76	371
33,354	38,796	206,112	48,935	24	132	6,399	3	18	150,778	73	405
12,024	20,870	85,404	6,765	8	18	4,111	5	11	74,528	87	161
42,590	53,154	228,987	75,210	33	295	4,514	2	18	149,263	65	585
30,809	43,493	192,117	52,664	28	151	4,574	2	13	134,879	70	388
32,599	47,152	179,982	65,295	36	335	3,023	2	15	111,664	62	573
50,483	78,267	273,154	97,122	36	310	4,089	2	15	171,943	62	612
70,813	139,832	396,512	127,700	32	378	6,091	2	18	262,721	66	777
48,415	146,253	317,342	67,544	21	265	11,051	4	43	238,747	75	936
49,482	116,254	270,829	79,679	29	335	10,313	4	43	180,837	67	750
57,161	108,075	315,482	125,450	40	401	7,165	2	23	182,867	58	584
39,182	66,225	197,224	57,347	29	315	6,265	3	34	133,612	68	734
25,701	38,349	151,065	52,427	35	248	5,919	4	28	92,719	61	440
42,244	51,230	237,804	76,991	32	275	5,276	2	19	155,537	66	555
62,447	163,789	353,679	103,333	29	353	10,450	3	36	239,896	68	819
45,051	74,038	242,332	90,978	38	332	7,605	3	31	143,749	59	525
31,100	44,546	170,667	47,003	27	197	7,965	5	34	115,699	68	486
45,801	81,795	262,217	94,486	36	353	4,727	2	18	163,004	62	609
63,895	112,640	346,152	152,705	44	383	9,849	3	25	183,598	53	460
48,654	81,844	259,854	99,862	38	317	11,266	4	36	148,726	58	472
30,904	82,255	186,838	28,232	15	110	9,281	5	36	149,325	80	581
37,995	85,582	203,038	57,663	28	162	7,162	3	20	138,213	69	388
15,198	22,531	85,735	25,574	30	86	3,261	4	11	56,900	66	191
20,817	39,239	114,570	36,610	32	107	4,810	4	14	73,150	64	214
45,612	90,256	235,626	86,353	37	138	10,063	4	16	139,210	59	222
26,384	25,615	149,435	39,597	26	130	4,297	3	14	105,541	71	347
31,410	34,558	168,885	80,956	48	208	4,304	3	11	83,625	49	214
22,779	31,327	114,354	43,680	38	199	3,177	3	14	67,497	59	307
43,478	51,978	233,205	69,883	30	155	5,319	2	12	158,003	68	350
190	71	555	..	..	..	16	3	·1	539	97	4
3,162	5,296	16,948	5,480	32	10	535	3	1	10,933	65	20
..	..	..	..	..	..	..	..	..	..	..	..
7,003	11,510	73,177	18,713	26	52	3,359	5	9	51,105	69	143
15,212	7,712	120,955	43,140	36	141	3,354	3	11	74,461	61	243
6,314	2,621	80,246	20,420	25	90	3,051	4	13	56,775	71	240
17,394	18,893	89,950	30,010	33	286	1,816	2	17	58,124	65	544
7,534	4,934	61,547	16,322	27	66	2,045	3	8	43,180	70	174
4,281	3,642	34,029	7,095	21	29	1,684	5	7	25,250	74	102
9,029	12,313	56,942	5,234	11	17	3,030	6	10	48,678	83	121
9, 398	19,348	45,582	18,018	40	62	3,116	7	11	24,448	53	84
16,853	25,740	81,139	42,504	52	173	1,849	2	8	36,786	46	150
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
1,943	4,078	15,806	1,149	8	6	1,148	8	6	13,509	84	66
6,142	15,800	44,879	11,717	26	32	2 443	5	7	30,719	69	85
..	..	..	..	..	..	..	..	..	..	..	..
1,149	2,811	16,066	3,891	24	18	505	3	2	11,670	73	53
429	161	3,069	736	24	5	36	1	2	2,297	75	15
..	..	..	..	..	..	..	..	..	..	..	..
3,045	2,808	36,995	13,423	36	51	1,142	3	4	22,430	61	85
4,893	4,113	32,677	6,193	19	26	2,004	6	9	24,480	75	102
5,334	7,497	35,169	961	3	4	2,236	6	9	31,972	91	132
1,078	1,147	7,801	1,060	14	7	615	8	4	6,126	78	42
3,526	1,449	18,170	4,067	22	29	1,177	6	8	12,926	72	93
5,358	7,212	31,548	10,725	34	70	1,201	4	8	19,622	62	128
3,533	6,416	26,452	4,756	18	40	2,575	10	21	19,121	72	154
7,272	13,073	45,226	17,967	40	111	966	2	6	26,293	58	163
3,248	2,825	15,113	5,180	34	28	237	2	1	9,696	64	53
6,431	5,259	39,099	15,938	41	73	1,207	3	6	21,954	56	101
13,765	28,333	67·560	34,544	51	147	2,778	4	12	30,238	45	129
7,700	14,205	39,187	11,897	30	32	1,837	5	5	25,453	65	69
828	2,486	5,374	..	..	..	247	5	2	5,127	95	35
..	..	..	..	..	..	..	..	..	..	..	..
788	610	2,240	255	11	2	290	13	2	1,695	76	12
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
1,494,056	2,613,736	8,722,626	2,619,329	30	117·4	277,097	3·2	12·4	5,826,200	66·8	261

APPENDIX B.

List of Trees in the deciduous forest, Mount Stuart, arranged roughly according to their abundance.

(*a*) *Very common.*

Adina cordifolia.
Albizzia odoratissima.
Anogeissus latifolia.
Dalbergia latifolia.
Dalbergia sissoides.
Dillenia pentagyna.
Grewia tiliaefolia.
Lagerstroemia lanceolata.
Phyllanthus emblica.
Pterocarpus marsupium.
Schleichera trijuga.
Stephegyne parvifolia.
Stereospermum chelenoides.
Stereospermum xylocarpum.
Tectona grandis.
Terminalia paniculata.
Terminalia tomentosa.
Terminalia crenulata (?)
Xylia xylocarpa.
Zizyphus jujuba.

(*b*) *Common.*

Bauhinia racemosa.
Bauhinia malabarica.
Bombax malabaricum.
Bridelia retusa.
Careya arborea.
Cassia fistula.
Cordia myxa.
Cordia wallichii.
Dalbergia paniculata.
Eugenia jambolana.
Garuga pinnata.
Givotia rottleriformis.
Gmelina arborea.
Grewia laevigata.
Hydnocarpus wightiana.
Hymenodictyon excelsum.
Macaranga roxburghii.
Machilus macrantha.
Odina wodier.
Sterculia villosa.
Terminalia belerica.
Trema orientalis.
Wrightia tinctoria.
Zizyphus œnoplia.
Zizyphus xylopyrus.

(*c*) *Infrequent.*

Albizzia procera.
Albizzia lebbek.
Alstonia scholaris.
Aporosa lindleyana.
Bischofia javanica.
Bombax insigne (?).
Butea frondosa.
Casearia tomentosa.
Cochlospermum gossypium.
Erythina spp.
Ficus glomerata.
Ficus hispida.
Ficus gibbosa.
Grewia asiatica.
Holarrhena antidysenterica.
Kydia calycina.
Mallotus phillipinensis.
Melia composita (*dubia*).
Spondias mangifera.
Sterculia guttata.
Sterculia colorata.
Vitex altissima.

(*d*) *Rare.*

Acacia leucophloea.
Ailanthus malabarica.
Bassia latifolia.
Buchanania latifolia.
Cedrela serrata.
Diospyros montana.
Lagerstroemia flos-reginae.
Limonia acidissima.
Sapindus laurifolius.
Stephegyne tubulosa.
Trewia nudiflora.
Zanthoxylum rhetsa.

APPENDIX C.

List of Trees identified in Karian Shola arranged approximately according to their position in the canopy, and their abundance.

		Number on marked specimen tree.
A. *Top story dominant trees*—		
**Hopea parviflora* (Irumbogam)	Very common	57
**Mesua ferrea* (Suruli)	Do.	59
†*Vitex altissima* (Mayiladi)	Do.	..
†*Aglaia roxburghiana* (Sembil)	Do.	14
†*Elaeodendron glaucum*	Do.	21
†*Polyalthia fragrans* (Nedunar)	Do.	28
Diospyros microphylla	Do.	56
†*Eugenia gardneri* (Naval)	Do.	12

---

* Timber trees which are at present saleable.

† Trees for which a market could probably be developed.

		Number on marked specimen tree.
**Calophyllum elatum* (*tomentosum* ?) (Poon)	Common	72
Bombax malabaricum (Poola)	Do.	..
Spondias mangifera (Ambalam)	Do.	4
†*Litsaea* sp. ?	Do.	32
Canarium strictum (Karukungiliyam)	Fairly common	54
†*Artocarpus lakoocha*	Do.	18
†*Bischofia javanica* (Sholaivengai)	Do.	55
**Artocarpus integrifolia* (Pilamaram)	Do.	71
Trewia nudiflora	Not very common.	5
Alstonia scholaris (Palai)	Do.	6
**Dysoxylum malabaricum* (Vellagil)	Do.	67
Machilus macrantha (Kolumavu)	Do.	20
†*Filicium decipiens*	Do.	35
Tetrameles nudiflora (Chini)	Do.	37
†*Carallia lucida*	Do.	48
**Mangifera indica* (Mavu)	Do.	53
Beilschmiedia bourdilloni	Do.	64
Pygeum wightianum	Do.	47
†*Chickrassia tabularis*	Uncommon	10
Antiaris toxicaria	Do.	20
**Acrocarpus fraxinifolius* (Malaiveppu)	Do.	50
Chrysophyllum roxburghii	Do.	31
**Cedrela toona* (Tun)	Do.	51
Ficus callosa	Do.	41
**Artocarpus hirsuta* (Aini)	Do.	52
Eugenia hemispherica ?	Do.	62

B. Subdominant trees with their crowns usually just below the top story—

Cinnamomum wightianum (?) (Lavangam)	Common	58
†*Pterospermum heyneanum*	Do.	3
Mimusops elengi (Elenji)	Do.	11
†*Amoora canarana*	Do.	27
Holigarna grahamii	Do.	33
Prosorus indicus	Do.	61
Ostodes zeylanica	Do.	63
Myristica laurifolia (Jathikai)	Do.	69
Cascaria esculenta	Fairly common	66
Actinodaphne hirsuta	Not very common.	45

C. Middle story trees—

Cyclostemon macrophyllus	Very common	16
Gomphandra polymorpha	Do.	22
Dimorpocalyx lawianus (?)	Do.	65
Nephelium longana	Common	1
Scolopia crenata	Do.	2
Excaecaria robusta	Do.	7
Diospyros bourdilloni	Do.	15
Acronychia laurifolia	Do.	17
Adenochlaena indica	Do.	23
Garcinia sp. (Xanthochymus ?)	Do.	49
Canthium didymum (Nanul)	Fairly common	8
Mallotus philippinensis	Do.	70
Flacourtia sepiaria	Do.	26
Sapindus laurifolius	Not very common.	39
Harpulia imbricata	Do.	34
Zanthoxylum rhetsa	Do.	42
Hydnocarpus wightiana	Do.	60
Vernonia arborea	Uncommon	40
Evodia roxburghii	Do.	36

D. Large Shrubs or small trees of lower story—

Orophea zeylanica	Fairly common	44
Nothopegia sp.	Do.	9
Ixora parviflora	Not very common.	13
Cipadessa fruticosa	Uncommon.	38

---

* Timber trees which are at present saleable.
† Trees for which a market could probably be developed.

APPENDIX D-1.

Samples of Control Forms.

Control Book.

Clear-felling Working Circle.

	Prescriptions of working plan.						Record of Operations carried out.			
	Locality to be exploited.						Locality exploited.			
Year of felling.	Coupe. No.	Compartment No.	Sub-compartment or section No.	Area of each sub-compartment or section.	Total area of coupe.	Nature of felling.	Year of felling.	Coupe No.	Compartment No.	Sub-compartment or section No.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
				ACS.	ACS.					
1931–32.	1	47	*a*	19·8	72·5	Clear-felling of all saleable timber.	1931–32	1	47	*a*
			c	35·2						*c*
		51	*e*	17·5					51	*e*
,,	1	77	*a*	27·3	203·6	Subsidiary fellings of timber over 7½ feet in girth.	,,	1	77	*a*
			b	94·1						*b*
		78	*a*	82·2						(part).
			(part)						78	*a*
										(whole).

	Record of Operations carried out—*cont.*								
	Locality exploited—*cont.*			Details of yield.					
Year of felling.	Area of each sub-compartment or section.	Total area of coupe.	Nature of felling.	Species, and form of produce.	Number of trees felled.	Number of logs, or units of other forms of produce.	Volume in cubic feet.	Total volume in cubic feet.	Remarks.
	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
	ACS.	ACS.							
1931–32.	20·4	77·1	Clear-felling of all saleable timber.	Teak logs ..	375	812	23,752		
	36·8			*Dalbergia latifolia* logs.	17	31	924		
	19·9			*Terminalia tomentosa* logs.	195	296	8,011		
				Terminalia paniculata logs.	182	317	10,321		
				Lagerstroemia lanceolata logs.	155	221	6,802		
				Grewia tiliaefolia logs.	76	193	4,823		
				Stereospermum xylocarpum logs.	2	3	87	54,720	
				Teak—spokes and felloes.	..	132 sets.	..		
				Teak poles ..	..	95 poles.	..		
,,	27·2	209·9	Subsidiary fellings of saleable timber over 7½ feet in girth.	Teak logs ..	92	275	6,481		
	85·1			*Dalbergia latifolia* logs,	12	28	1,421		
	97·6			etc.	Etc.	Etc.	Etc.	23,58	

APPENDIX D-2.

CONTROL BOOK.

Selection-felling Working Circle.

Prescriptions of the working plan.							Record of Operation.					Record of Operations carried out.							
		Locality to be exploited.							Locality.			Locality exploited.		Details of yield.					
Year of felling.	Nature of felling.	Coupe No.	Compartment No.	Sub-compartment or section.	Area of each sub-compartment or section.	Total area of coupe.	Year of felling.	Nature of felling.	Coupe No.	Compartment No.	Sub-compartment or section.	Area of each sub-compartment or section.	Total area of coupe.	Species, and form of produce.	Number of trees felled.	Number of logs, or units of other form of produce.	Volume in cubic feet.	Total volume in cubic feet.	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
								Mount Stuart Felling Series.											
					ACS.	ACS.													
1931–32.	Selection felling of all saleable timber of 7½ feet girth and over.	1	49 51 52	*a* *c* *a* *b* (part)	75·2 28·1 118·3 31·1	252·7	1931–32	Selection felling of all saleable timber of 7½ feet girth and over.	1	49 52	*a* *a* *b* (part).	75·9 122·2 29·3	227·4	Teak logs .. *Dalbergia latifolia* logs, *Pterocarpus Marsupium* logs. etc.	290 37 42 Etc.	571 82 94 Etc.	15,822 2,701 3,588 Etc.	37,811	
														Teak spokes and felloes.	..	88 sets.	..		
								Ulandi Felling Series.											
	Selection felling of all saleable timber of 7½ feet and over.	(No definite area specified).					1931–32	Selection felling of all saleable timber of 7½ feet girth and over.	..	117 (part). 119 (part).	.. ..	95·3 132·7	228·0	Teak logs .. *Dalbergia latifolia* logs, etc.	395 35 Etc.	1,295 91 Etc.	43,700 3,406 Etc.	87,053	
	Clear-felling of all saleable timber.	..	..	..	..	.. At least 50 acres.		Clear-felling of all saleable timber.	..	119 (part).	..	65	65	Teak logs .. *Dalbergia latifolia* logs, etc.	152 15 Etc.	421 37 Etc.	12,131 2,412 Etc.	23,195	

NOTE.—Columns 1-7 should be filled in from the tabular statement of operations (Part II, Chapter III, Section II).

APPENDIX D-3.

CONTROL BOOK.

Bamboo Working circle.

Year of working.	Prescriptions of working plan.	Record of operations actually carried out.				Remarks.
		Locality exploited.	Area.	Amount realized.	Quantity of bamboos extracted.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
				RS.		
1931–32.	Whole of the Mount Stuart and Tekkadi Leased Forest blocks to be leased out.	Coupes I, III and IV of the Selection Felling Working Circle and Coupes II and III in the Clear-felling Working Circle.	875	1,350	14,800	Many of the bamboos extracted were in flower hence lower rates realized.

NOTE.—When a regular scheme for bamboo exploitation is compiled in 1934, a control form suitable to the prescriptions for exploitation should be made.

APPENDIX D-4.

CONTROL BOOK.

Minor Produce Working circle.

Year of working.	Prescriptions of the working plan.	Method of collection actually carried out.	Details of the produce extracted.								Remarks
			Species and form of the produce.	Quantity collected.	Cost of collection.			Revenue realized.			
(1)	(2)	(3)	(4)	(5)	(6)			(7)			
					RS.	A.	P.	RS.	A.	P.	
1931–32.	Departmental collection of minor produce throughout the whole working plan area, except in the new Ulandi area.	Produce collected departmentally from the whole working plan area except the new Ulandi range where the collection will be through the agency of contractors.	Ginger (*Zingiber Officinale*) Green roots.	24 maunds 20 seers.	15	5	0	22	8	0	
			Kungiliam (*Canarium strictum*) Black Dammar.	18 maunds.	36	0	0	42	4	0	
			Honey	* 335 measures.	125	10	0	188	12	0	* Small 'Coimbatore' measures.
			Canes (*Calamus viminalis*)—large.	650	19	8	0	28	4	0	
			Canes (*Calamus viminalis*)—medium.	800	20	0	0	26	8	0	
			Canes (*Calamus viminalis*)—small.	250	3	2	0	3	8	0	
			Etc.	Etc.	Etc.			Etc.			
			Total ..	..	637	8	0	1,962	12	0	
	Departmental elephant capturing operations.	Elephants captured departmentally.	Elephants— Haider	..	3,817	4	0	2,850	0	0	Sold.
			Tippu					..			Died.
			Ali Khan ..					1,200	0	0	Sold.
			Meenakshi ..					950	0	0	Retained by department.

NOTE.—When elephants are retained by the department or handed over to the Raja of Kollengode, their book value should be entered in column (7). Otherwise their actual sale value should be entered. The value of elephants that escape or die in captivity in the year of capture should not be entered.

APPENDIX D-5.

RECORD OF WORKS.

Clear-felling Working circle.

Prescriptions of the Working Plan.*							Record of Works actually carried out.								
		Locality.						Locality.							
Year of working.	Nature of operations.	Coupe number.	Compart-ment number.	Sub-com-partment or section.	Area of sub-com-partment or section.	Total area.	Year of working.	Coupe number.	Compart-ment number.	Sub-com-partment or section.	Area of sub-com-partment or section.	Total area.	Details of work done.	Cost.	Remarks.
(1)	(2)	(3)	(4)	(5)	6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
					ACS.	ACS.					ACS.	ACS.		RS. A. P.	
	Section (i)—Works definitely prescribed.									*Section (i)—Works definitely prescribed.*					
1934–35 ..	Formation of plantation and first-year tending.	III	27 24	*a* *b* (part), *a*	29·1 35·2 11·3	75·6	1934–35	III II	27 26	*a* *b* (part), *d* † *c* (part) †	28·6 36·4 15·1 21·0	101·1	Formation and first year tending of plantation.	5,924 8 1	(For details vide Regeneration Ledger). † 36·1 acres — arrears of coupe II which should have been regenerated in the previous year. This leaves 10·6 acres of Coupe III to be regenerated next year.
	Second year tending of 1933 regeneration area.	II	26 25	*a* *b* *c*	25·1 27·2 19·1	71·4									
	Thinnings— First thinning—1928	Regeneration area.		..	..	144		1927 Regeneration area (remainder)				65	First thinning—1,257 poles extracted.	148 10 0 ‡	‡ Includes cost to dragging poles to the road side but does not include carting to Pollachi.
								1928 Regeneration area.				144	First thinning— 4,985 poles extracted.	310 2 0 ‡	
	Second thinning—1922	,,	..	..	..	126		1922	,,			126	Second thinning—2,122 poles extracted.	247 5 0 ‡	
	Third thinning—1916	,,	..	..	..	5		1916	,,			5	Third thinning—95 poles extracted.	11 1 0 ‡	
	Marking of seed trees— Teak—250 trees *Dalbergia latifolia*—20 trees. *Pterocarpus Marsupium*—45 trees.	..	..	..	..	..	..	..	..	..	..	..	Marking of seed trees— Teak—180 *Dalbergia latifolia* 20. *Pterocarpus Marsupium*—30	179 8 0 §	§ Cost of marking and fixing boards.
	Formation of Nursery ..	..	..	..	..	..	..	..	..	..	..	..	Re-forming last year's nursery.	975 11 0	For details see Nursery Ledger.
	Fire-protection of plantations— (*a*) Clearing 50-foot wide lines round large blocks of plantation.	..	..	..	..	..	..	..	..	..	..	..	Fire-protection of plantation— (*a*) 50-foot line round large blocks of plantation—new clearing—66 chains. 50-foot line round large blocks of plantation—re-clearing existing line and burning 630 chains.	650 0 0 227 0 0	Revenue by sale of 1,125 cubic feet of timber from this line Rs. 1,633.

---

* Columns (1) to (7) should be filled in from the summary of prescriptions for sections (i) and (ii). They will be left blank for section (iii).

APPENDIX D-5—*cont.*

Record of Works—*cont.*

Clear-felling Working Circle—cont.

Presentations of the Working Plan. *							Record of Works actually carried out.								
		Locallly.						Locally.							
Year of working.	Nature of operations.	Coupe number.	Compart-ment number.	Sub-com-partment or section.	Area of sub-com-partment or section.	Total. area.	Year of working.	Coupe number.	Compart-ment number.	Sub-com-partment of section.	Area of sub-com-partment or section.	Total area.	Details of work done.	Cost.	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
														RS. A. P.	
	(*b*) Clearing 12-foot wide lines round all other plantations.	..	..	..	..	..	..	..	..	..	..	..	(*b*) Clearing 12 foot-lines round plantations—210 chains.	49 7 0	
	(*c*) Clearing interna fire-lines. Etc., etc.	..	..	..	..	..	..	..	..	..	..	..	(*c*) Clearing internal fire-lines, *Nil.* Etc., etc.	..	
Section (ii)—Works suggested but not definitely prescribed.							*Section ii)—Works suggested but not definitely prescribed.*								
	Artificial weathering of seed, etc., etc.	..	..	..	..	..	..	..	..		..	..	220 bags of teak seed weathered for months, and turned over weekly, etc.	7 5 0	

[Note.—In this section, only suggested works that are entirely separate from definitely prescribed works should be entered. For instance suggested improvements in the method of forming plantations will not find place here as hey will be recorded in section (i) under "Formation of Plantations" which is a definitely prescribed work.]

Section (iii)—Works which have been carried out though not prescribed.							*Section (iii)—Works which have been carried out though not prescribed.*								
	..	..	..	..	..	..	..	..	..	..	..	..	Building temporary dam across Sickalipallam with irrigation channel for irrigating teak stump nursery.	18 10 0	
	..	..	..	..	..	..	..	..	..	..	..	..	Artificial introduction of Artocarpus hirsuta in 10 acres of 1926 plantation by stump planting at 6 feet by 6 feet espacement, etc.	112 0 0	

---

* Columns (1) to (7) should be filled in from the summary of prescriptions for sections (i) and (ii). They will be left blank for section (iii).

Note.—1. All items of work done must be recorded and full details given here if they have not already been given in the Nursery or Regeneration Ledger.

2. A similar form, maintained in the same way, will be used for the Selection Felling Working Circle, and the Karian Shola Working Circle.

3. Works not particularly appertaining to any one working circle will be entered in the Record of Works, Miscellaneous (vide the next form).

APPENDIX D-6.
RECORD OF WORKS.
Miscellaneous.

Prescriptions of the working plan.			Record of works carried out.					
Year. (1)	Nature of work. (2)	Brief details of work. (3)	Year. (4)	Nature of work. (5)	Brief details of work. (6)	Cost of each item. (7)	Total cost of each work. (8)	Remarks. (9)
						RS. A. P.	RS. A. P.	
1934–35 ..	Construction of buildings.	New Serambi between Sungam and Tellikal.	1934–35 ..	Construction of buildings.	New Serambi at Pillakalparai—			
					Timber for posts, including fashioning.	235 12 0		
					Sawing planks	98 2 0		
					Erection	117 0 0		
					Thatching roof	56 10 0		
					etc. etc. etc.	etc.	1,634 2 10	
	Maintenance of buildings.	Top Slip rest-house, rangers' quarters, Range office, Forest Guards' Lines, shop, etc.	..	Maintenance of buildings.	Whitewashing Top Slip rest-house .. .. RS. A. P. 17 8 0	95 12 0		
					Whitewashing Rangers' quarters 22 12 0			
					Whitewashing Range office, etc., etc. 11 5 0			
					Petty repairs—Top Slip rest-house, etc., Range office, etc.	etc.	1,784 10 0	
	Construction of roads.	Constructing branch cart-track from the saddle on the Tekkadi road north-east of Mangajam to Shemunguli Pallam, total length 2 miles 2 furlongs.	..	Construction of roads.	Completed portion (prescribed for 1933–34) from saddle north-east of Mangajam to the Forest rest-house at Elathodu (5 furlongs)—earth road 12 feet wide.	1,625 3 0		
					Started branch track from same saddle to Shemanguli Pallam—earth road 12 feet wide—1 mile 4 furlongs constructed.	3,621 4 0	5,246 7 0	Arrears should be made up next year.
	Maintenance of roads.	All existing roads to be maintained in good order.	..	Maintenance of roads.	*Top Slip Ghaut Road*—Clearing side drains (5 miles 2 furlongs), remetalling (1 mile 1 furlong), collecting metal (4 miles 1 furlong), patch repairs (3 miles 2 furlongs), repairs to culverts, etc., etc.	4,625 4 0		
					Top Slip-Anaipadi Road—etc. etc.	2,800 6 0 etc.	9,437 10 0	
	General fire-protection.	External fire-lines (here give details of prescribed lines, guide lines, fire tracing, etc.).	..	General fire-protection.	External fire-lines (give details of fire lines other than those connected with direct protection of plantations).			
		Fire patrols (give details prescribed or suggested), etc., etc.	..	....	Fire patrols, etc., etc.			

APPENDIX D-7

Annual Summary of Revenue.

Year.	Revenue from						Other sources, as specified		Total revenue.
	Timber.	Spokes and felloes.	Bamboos.	Fuel.	Minor produce.	Sale of elephants and other livestock.	Revenue.	Source from which obtained.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.		RS. A. P.
1931-32 ..	1,82,955 8 0	6,257 10 0	1,800 0 0	37 2 0	987 3 0	6,125 0 0	55 3 0	Sale of tools and stores written off.	
							2,500 0 0	Sale of small timber and bamboos from clear-fellings.	2,00,717 10 0
1932-33, etc.	..	..	..	..	..	..	..	..	..

APPENDIX D-8.

Annual Summary of Expenditure.

Year.	Lease payments.	Conservancy.		Exploitation.				
		Regeneration including tending thinning, etc.	Fire protection.	Timber, poles, smallwood, and fuel (including consignment charges).	Spokes and felloes.	Minor produce.	Bamboos.	Livestock.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.		RS. A. P.
1931-32	2,500 0 0	7,521 8 0	2,290 8 0	71,231 4 0	2,213 12 0	425 0 0	Nil.	16,330 0 0

Year.	Works.			Elephant capturing. (13)	Miscellaneous. (14)	Establishment.		Total expenditure. (17)
	Roads and paths. (10)	Buildings. (11)	Other works. (12)			Pay and allowances. (15)	Contingencies. (16)	
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
1931- 2	8,231 8 0	605 8 0	2,155 0 0	4,212 10 0	175 3 0	45,112 8 0	1,611 1 0	1,64,615 6 0

Left hand page.

Right hand page.

APPENDIX D-9.

NURSERY LEDGER.

Nursery to be sown in year— Size. Acres. Units.
Number of beds Size of beds—
Whether new nursery, or old nursery used for years previously.
Estimated number of $\frac{\text{stumps}}{\text{seedlings}}$ required.
Actual number of $\frac{\text{stumps}}{\text{seedlings}}$ produced.

Number of beds sown— Quantity of seed used—
Method of sowing—
Method of raising stumps *—
Number of beds of transplant †— Espacement of transplants †—
Remarks on stocking of beds, amount of failure, etc.

Year and month.	Clearing and burning.	Uprooting stumps.	Fencing.	Formation of beds.		Cost of seed including treatment.	Cost of sowing.	Watering.	Weeding, thinnings and other tending.	Transplanting in nursery.	Preparation of stumps.	Number of stumps prepared.	Other items of expenditure (specify).	Remarks.
				Original.	Re-forming.									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	RS. A. P.	RS. A. P.	RS. A. P.											
1931.														
August	135 2 0	..	..	..	..	..	..	..	..	..	..	..	..	..
September	10 4 0	..	..	..	..	..	..	..	..	..	..	..	..	..
October	..	85 1 0	..	..	..	..	..	..	..	..	..	..	..	..
November	..	..	17 3 0	..	..	..	..	..	..	..	..	..	..	..
December	..	..	..	..	..	..	..	..	..	..	..	..	..	..
1932.														
January	22 8 0	..	..	..	..	..	..	..	..	..	..	..	..	..
February	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Etc.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

Grand total .. Rs.
Total cost per 1,000 stumps .. Rs.

Disposal of plants and cost.

Species.	Where used.	Number of plants.	Cost.

NOTE.—Annual abstracts from this ledger will be posted in the District Forest Office in a similar form.

---

* Whether direct in original seed-beds, or by transplanting to nursery lines.
† To be filled in only if transplanting is done.

Left hand page.

Right hand page.

APPENDIX D-10.

REGENERATION LEDGER FOR THE CLEAR-FELLING WORKING CIRCLE.

Year of plantation
Date of timber felling from to
Date of clear-felling from to
Date of burning.
Period of piling and reburning from to
Subordinate establishment in special charge.
Rate of daily wages of coolies.

Compartment No.	Section or Sub-compartment.	Area in acres.

Species introduced.	Area of each species regenerated.	Espacement.	Method of regeneration.	Dates of sowing or planting each species.	Remarks.

Percentage of stocking at beginning of second growing season for each species separately :—
Teak per cent, *Dalbergia latifolia* per cent, *Pterocarpus Marsupium* per cent.
Do. at beginning of third growing season.

Month and year.	Clear-felling.	First burn.	Piling and reburning.	Cost of seed.	Proportion of nursery costs.	Aligning and staking.	Making inspection path.	Dibbling seed at stake (original).	Stump planting (original).	Replacing casualties.	Freeing, weeding and soil working.	Fire-protection (per cent by area).	Other expenditure [specify details in column (15).]	Details of other expenditure.	Monthly rainfall in inches.	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)

NOTE.—This record will be maintained in the above form by the Range Officer, who will enter all expenditure monthly. The total of each column will be struck annually on 31st March previous annual totals being included so as to give the total cost from the commencement of the plantation. An abstract in the same form will be kept in the District Forest office in which yearly totals only are recorded. The record will only be maintained until the plantation is established, which will normally be at the end of three years.

Left hand page.

Right hand page.

APPENDIX D-11.

LEDGER FOR GAP REGENERATION.

Year of regeneration. Number of coupe regenerated. Area. Acres.

Number of gaps regenerated. Average size of gap.

Average number of patches per gap.

Species introduced.

Distribution of species in gaps.

Subordinate staff in special charge.

Wages of coolies.

Average stocking of gaps at beginning of second growing season.

Average stocking of gaps at beginning of third growing season.

Month and year.	Billeting and piling including enlarging gaps.	Fire lines.	Burning the piles.	Staking and preparation of the ground.	Cost of seed.	Sowing at stake.	Cost of stumps.	Stump planting.	Replacement of casualties.	Freeing, weeding and soil working.	Other expenditure [specify details in column (13)].	Details of other expenditure.	Total cost at end of each year.	Total cost per acre at end of each year.	Average cost per gap at end of each year.	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)

NOTE.—This form will be used for gap regeneration in both the Selection Working Circle and the Karian Shola Working Circle. In the latter case, column (2) will be altered to "Clearing the ground," and columns (3) and (4) will not be required. The ledgers will be maintained monthly by the Range Officer, and annually in the District Forest office, as described for the Clear-felling Working Circle.

APPEN

Com

COMPART

Sub-compartment. (1)	Classification. (2)	Area. (3)	Area of compartment. (4)	Aspect. (5)	Slope. (6)
a ..	.. Clear felling working circle	49·96	369·69	South-west ..	.. Easy to moderate ..
b ..	.. Selection working circle	63·82			
c ..	.. Karian shola working circle ..	7·82			
d ..	.. Unworkable	248·09			

GROWING

Sub-compartment.	Teak.				Rosewood.			
	3′ to 6½′	6½′ to 7½′	Over 7½′	Total.	3′ to 6½′	6½′ to 7½′	Over 7½′	Total.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	C.FT.	C.FT.	C.FT.	C.FT.	C.FT.	C.FT.	C.FT.	C.FT.
a ..	1,368	500	564	2,432	1,024	241	386	1,681
b ..	1,246	239	300	1,785	1,688	203	403	2,294
c ..				Correct figures not available.				
d ..				Unworkable.				
Total.	2,614	739	864	4,217	2,712	444	789	3,975

TIMBER FELLED

Year.	Sub-compartment.		Teak.				Rosewood.			
			to 6½′	6½′ to 7½′	Over 7½′	Total.	3′ to 6½′	6½′ to 7½′	Over 7½′	Total.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		ACS.	C.FT.	C.FT.	C.FT.	C.FT.	C.FT	C.FT.	C.FT.	C.FT.
1936	a ..	49·96	..	..	595	595	..	..	394	394
1939	b (part)	35·12	..	..	168	168	..	..	195	195
Total ..		85·08	..	..	763	763	..	..	589	589

DIX E.

partment 104.

MENT.

Soil.	Mean density.	Undergrowth.	Regeneration.
(7)	(8)	(9)	(10)
Sandy loam ..	·5	Lantana is scattered throughout a and b, and is dense in south-west corner of b. Srobilanthes dense throughout c.	There are patches of Rosewood regeneration along the northern boundary, otherwise regeneration is wanting.

STOCK IN 1931.

Other saleable species.				Total stock.				Remarks.
3′ to 6½′	6½′ to 7½′	Over 7½′	Total.	3′ to 6½′	6½′ to 7½′	Over 7½′	Total.	
(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
C.FT.	C.FT.	C.FT.	C.FT.	C.FT.	C.FT.	C.FT.	C.FT.	
30,486	3,910	5,000	39,396	32,878	4,651	5,950	43,479	Dense bamboos throughout the sub-compartment.
24,902	6,447	2,000	33,349	27,836	6,889	2,703	37,428	Bamboos scanty.
				Correct figures not available.				
				Unworkable.				
55,388	10,357	7,000	72,745	60,714	11,540	8,653	80,907	

1931 TO 1941.

Other saleable species.				Total stock.				Remarks.
3′ to 6½′	6½′ to 7½′	Over 7½′	Total.	3′ to 6½′	6½′ to 7½′	Over 7½′	Total.	
(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
C.FT.	C.FT.	C.FT.	C.FT.	C.FT.	C.FT.	C.FT.	C.FT.	
..	..	4,931	4,931	..	..	5,920	5,920	Subsidiary fellings in coup VI.
..	87	1,311	1,398	..	87	1,674	1,761	Selection fellings, coupe IX. fallen tree.
..	87	6,242	6,329	..	87	7,594	7,681	

NOTE.—Totals to be made at end of Working Plan period.

HISTORY OF COMPARTMENT.

Year.	Particulars.
1923	The southern half of the compartment was worked by selection fellings under Mr. Wood's working plan.
1934	Bamboos flowered throughout the compartment.
1937	Severe fire killed back all regeneration and saplings up to 1½ inches in diameter, and also damaged standing timber.
1940	Gap regeneration (136 gaps) done in 35·1 acres of sub-compartment b. Teak, rosewood, and *Pterocarpus marsupium* introduced.
1941	*Strobilanthes* flowered in sub-compartment c.

APPENDIX F-1.

Provisional Volume Table for *Tectona grandis* in mixed forest (Mount Stuart).

Length of merchantable bole in feet.

Breast height girth glass in feet.	10	15	20	25	30	35	40	45	50	55	60	65	70
3–4	8	12	16	19	22	25	28	29	31	33	35	36	..
4–5	12	16	21	25	29	33	36	39	42	44	47	49	50
5–6	16	22	28	33	38	43	47	51	55	58	60	63	65
6–7	20	28	35	42	48	55	60	65	70	74	77	80	83
7–8	25	35	44	52	60	68	75	81	88	93	98	102	105
8–9	31	43	54	65	76	85	94	102	110	116	123	127	130
9–10	36	52	67	80	94	105	116	126	137	144	151	155	159
10–11	41	62	82	98	115	127	145	155	165	175	183	188	193
11–12	51	75	98	121	142	164	180	193	204	216	226	232	236
12–13	61	88	115	142	169	190	208	224	239	254	262	271	279
13–14	72	101	131	159	187	210	231	250	269	289	297	309	319
14–15	82	113	142	173	203	228	250	274	295	313	328	344	353
15–16	91	125	154	184	216	244	270	294	318	338	357	372	383
16–17	98	134	162	194	227	256	285	313	337	359	377	395	406
17–18	104	141	169	200	235	266	296	325	350	375	392	412	424

(Compiled from data for 867 trees.)

APPENDIX F-2.

Provisional Volume Table for *Dalbergia latifolia* in mixed forest (Mount Stuart).

Length of merchantable bole in feet.

Breast height girth class in feet.	10	15	20	25	30	35	40	45	50	55	60	65	70
3–4	6	9	11	13	15	16	17	19	20	22	23	24	..
4–5	10	13	17	21	24	26	28	31	34	38	40	41	42
5–6	13	17	23	28	34	39	40	43	48	51	54	56	57
6–7	16	23	31	39	44	50	55	60	63	67	70	73	76
7–8	21	31	40	49	59	66	74	82	87	93	99	103	105
8–9	26	39	51	62	74	84	95	105	112	120	126	130	132
9–10	31	48	62	76	90	103	116	128	138	147	153	157	159
10–11	36	56	78	97	118	131	151	161	170	180	186	191	193
11–12	48	71	97	125	148	169	184	193	204	212	220	223	226
12–13	56	86	118	148	174	192	207	218	228	240	241	251	255
13–14	67	101	136	164	190	208	222	238	249	259	268	274	279
14–15	78	115	148	177	203	221	238	253	266	277	284	289	294

(Deduced from the Provisional Teak Volume Table by factors derived from the tree-volume figures given in Mr. Wood's Working Plan.)

APPENDIX F-3.

Provisional Volume Table for *Terminalia tomentosa* in mixed forest (Mount Stuart).

Length of merchantable bole in feet.

Breast height girth class in feet.	10	15	20	25	30	35	40	45	50	55	60	65	70
3–4	8	12	16	20	25	29	33	37	41	44	47	50	..
4–5	10	16	22	27	33	38	42	47	52	57	61	64	68
5–6	13	19	27	34	41	46	52	58	64	69	72	78	82
6–7	17	24	35	43	50	58	65	72	79	84	89	96	104
7–8	21	30	41	50	59	66	74	81	89	96	103	109	116
8–9	25	37	50	61	72	81	89	98	108	116	124	132	139
9–10	32	45	60	72	85	95	105	116	127	136	145	156	163
10–11	38	54	70	85	98	110	123	135	145	156	166	175	183
11–12	46	63	81	97	114	129	144	155	168	180	190	199	205
12–13	53	73	94	112	130	147	166	179	194	204	215	224	231
13–14	60	84	103	126	144	169	191	205	219	232	244	251	261
14–15	72	98	124	148	168	194	215	230	244	259	271	283	293
15–16	82	110	138	165	189	216	236	253	269	286	302	314	322
16–17	93	124	152	183	208	233	256	274	291	319	327	338	348

(Deduced from the Provisional Volume Table for Teak by factors derived from the tree-volume figures given in Mr. Wood's Working Plan.)

N.B.—This table should be used for calculating the volumes of *Stephegyne parvifolia* and *Adina cordifolia.*

APPENDIX F-4.

Provisional Volume Table for *Terminalia paniculata* in mixed forest (Mount Stuart).

Breast height girth class in feet.	Length of merchantable bole in feet.												
	10	15	20	25	30	35	40	45	50	55	60	65	70
3–4	6	9	12	14	16	18	19	20	22	24	25	26	..
4–5	10	14	18	22	26	28	30	33	36	40	43	44	45
5–6	13	19	25	30	36	41	44	47	51	55	58	60	61
6–7	17	25	33	41	47	53	57	63	67	71	76	79	82
7–8	22	32	43	52	62	69	78	86	92	98	104	107	109
8–9	26	40	52	64	76	86	97	107	115	122	128	132	134
9–10	31	48	62	76	90	103	116	128	138	147	153	157	159
10–11	36	56	78	97	118	131	151	161	176	180	186	191	193
11–12	48	71	97	125	148	169	184	193	204	212	220	223	226
12–13	56	86	118	148	178	192	207	218	228	236	241	251	255
13–14	67	101	136	164	190	208	222	238	249	259	268	274	279
14–15	78	115	148	177	203	221	238	253	266	277	284	289	294

(Deduced from the Provisional Teak Volume Table by factors derived from the tree-volume figures given in Mr. Wood's Working Plan.)

APPENDIX F-5.

Provisional Volume Table for *Lagerstroemia lanceolata* in mixed forest (Mount Stuart).

Breast height girth class in feet.	Length of merchantable bole in feet.												
	10	15	20	25	30	35	40	45	50	55	60	65	70
3–4	6	9	12	15	17	18	19	20	22	24	25	26	..
4–5	9	14	18	22	25	28	30	33	36	39	42	45	46
5–6	13	19	25	31	36	40	44	48	52	55	59	60	61
6–7	18	24	33	41	49	54	59	63	67	72	76	80	82
7–8	22	32	42	53	63	70	76	81	87	93	97	99	100
8–9	27	40	53	66	77	88	95	101	107	112	115	117	119
9–10	33	51	66	81	96	107	116	123	129	134	138	140	141
10–11	40	62	83	102	114	125	136	143	147	151	154	156	157
11–12	50	75	102	121	135	146	153	157	161	165	168	170	171
12–13	61	92	119	135	148	156	162	167	171	175	177	179	180
13–14	72	106	128	145	155	163	169	174	178	181	183	185	186

(Deduced from the Teak Volume Table by factors derived from the tree-volume figures given in Mr. Wood's Working Plan.)

APPENDIX F-6.

Provisional Volume Table for *Grewia tiliaefolia* in mixed forest (Mount Stuart).

Breast height girth class in feet.	Length of merchantable bole in feet.												
	10	15	20	25	30	35	40	45	50	55	60	65	70
3–4	6	7	8	10	11	13	14	15	16	17	18	19	..
4–5	8	10	13	16	19	21	22	24	26	27	29	31	32
5–6	10	14	18	22	26	28	31	34	37	39	40	41	42
6–7	12	18	24	28	35	38	41	44	47	50	53	55	57
7–8	16	23	31	37	44	49	55	61	67	73	78	81	83
8–9	20	29	39	48	57	65	75	84	92	101	106	109	111
9–10	25	36	48	58	70	82	95	107	117	125	128	137	139
10–11	30	45	60	75	96	110	131	141	150	157	163	168	171
11–12	36	55	75	103	127	149	161	171	178	185	190	193	195
12–13	45	65	96	127	153	169	180	188	196	203	206	209	212

(Deduced from the Teak Volume Table by factors derived from the tree-volume figures given in Mr. Wood's Working Plan.)

APPENDIX F-7.

Provisional Volume Table for *Pterocarpus marsupium* in mixed forest (Mount Stuart).

Breast height girth class in feet.	Length of merchantable bole in feet.												
	10	15	20	25	30	35	40	45	50	55	60	65	70
3–4	5	7	9	11	13	14	15	16	17	18	19	20	21
4–5	7	11	14	17	19	21	23	25	27	29	31	33	34
5–6	10	15	18	23	27	31	33	35	38	41	44	46	47
6–7	13	19	25	31	36	40	44	48	51	55	58	61	63
7–8	17	24	31	39	47	54	60	66	70	74	77	79	81
8–9	21	30	40	50	60	69	75	81	86	91	94	97	98
9–10	25	37	49	61	73	82	90	97	103	108	112	115	116
10–11	29	45	62	78	91	100	110	116	123	129	133	136	138
11–12	37	56	78	96	109	122	131	138	145	150	154	156	158
12–13	45	68	91	109	125	137	146	153	159	165	169	171	174
13–14	54	81	102	119	136	147	156	164	170	175	179	183	185

(Deduced from the Teak Volume Table by factors derived from the tree-volume figures given in Mr. Wood's Working Plan.)

N.B.—This table should be used for all miscellaneous species except *Stephegyne parvifolia* and *Adina cordifolia*.

Proceedings of the Chief Conservator of Forests

Proceedings R. No. 498, Press, 11th November 1932

Working Plan—Mount Stuart Forests—Sanctioned.

R. D. RICHMOND, Esq., C.I.E., I.F.S.,
Chief Conservator of Forests.

READ—the following papers :—

I

Revised Working Plan for the Mount Stuart Forests.

II

G.O. Ms. No. 1796, Development, dated 17th December 1931.

Read—the following paper :—

From the Chief Conservator of Forests, Ref. No. 9290/30 C-1, dated 26th October 1931.

Order—Ms. No. 1796, *Development, dated* 17*th December* 1931.

The Government are pleased to sanction the Revised Working Plan for the Mount Stuart Forests, South Coimbatore Division, received with the Chief Conservator's letter read above.

(By order of the Governor in Council)

S. V. RAMAMURTI,
Secretary to Government.

To the Chief Conservator of Forests.
,, Superintendent, Government Press.

Proceedings—R. No. 498, Press, dated 11th November 1932.

Recorded.

R. D. RICHMOND,
Chief Conservator of Forests.

(True copy)

V. G. DARRINGTON,
Personal Assistant.

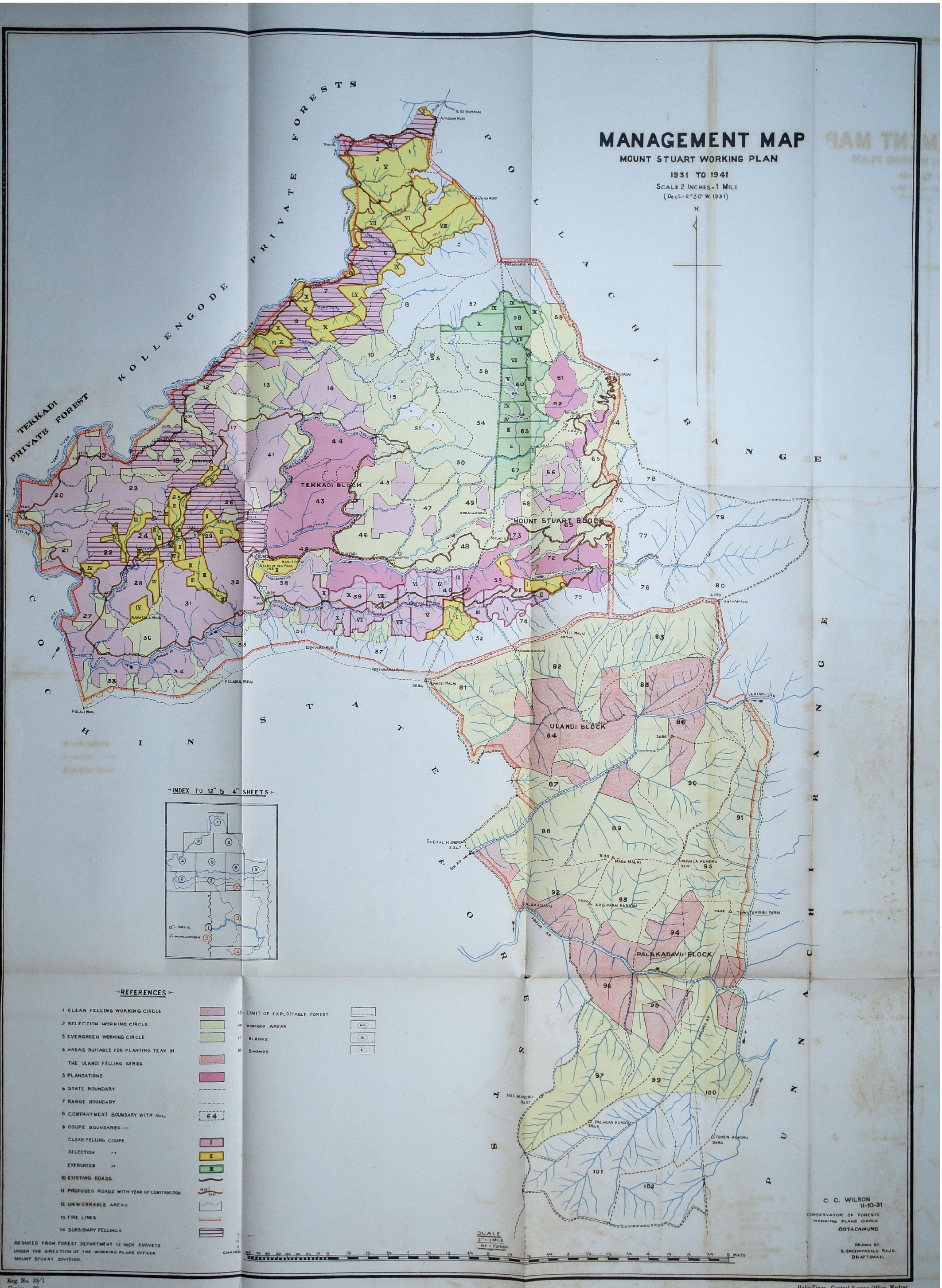
To the Conservator, III (Working Plans) Circle.
,, ,, Fifth Circle.
,, District Forest Officer, South Coimbatore.

Copy to the other Conservators and District Forest Officers, including Special Forest Officer, Parlakimedi Maliahs.
,, Principal, Forest College.
,, Provincial Sylviculturist.
,, Working Plans Officers.
,, President, Forest Research Institute, Dehra Dun.

MANAGEMENT MAP
MOUNT STUART WORKING PLAN

1931 TO 1941

SCALE 2 INCHES - 1 MILE
(Decl.- 2°30' W. 1931)


N
TEKKADI PRIVATE FOREST
KOLLENGODE PRIVATE FORESTS
POLACHI RANGE
COCHIN STATE FORESTS
PUNACHI RANGE
TEKKADI BLOCK
MOUNT STUART BLOCK
ULANDI BLOCK
PALAKADAVU BLOCK
PERIYAVARAI MALAI
SHEKAL KUNDRU 2347
NADU MALAI
MAVALA KUNDRU
ARISIPARAI KARADU
PALAKADAVU
NAI KUNDRU
PALAGAN KUNDRU
TUMEN KUNDRU
PULALI MUDI
PILLAIKAL PARAI
VARIGALIAR
INDEX TO 12" & 4" SHEETS
12" SHEETS
4" ANAMALAI RESERVE
SCALE
2" = 1 MILE
RF = 1/31680
CHAINS
5 MILES

REFERENCES

1 CLEAR FELLING WORKING CIRCLE	🟪
2 SELECTION WORKING CIRCLE	🟨
3 EVERGREEN WORKING CIRCLE	🟩
4 AREAS SUITABLE FOR PLANTING TEAK IN THE ULANDI FELLING SERIES	🟥
5 PLANTATIONS	🟪
6 STATE BOUNDARY	-·-·-
7 RANGE BOUNDARY	········
8 COMPARTMENT BOUNDARY WITH Nos.	64
9 COUPE BOUNDARIES:—	
CLEAR FELLING COUPE	I
SELECTION ,,	II
EVERGREEN ,,	III
10 EXISTING ROADS	~
11 PROPOSED ROADS WITH YEAR OF CONSTRUCTION	1936 1937
12 UNWORKABLE AREAS	◡
13 FIRE LINES	┴┴┴
14 SUBSIDIARY FELLINGS	▤
15 LIMIT OF EXPLOITABLE FOREST	----
16 BAMBOO AREAS	BA
17 BLANKS.	B
18 SWAMPS.	S

REDUCED FROM FOREST DEPARTMENT 12 INCH SURVEYS
UNDER THE DIRECTION OF THE WORKING PLANS OFFICER
MOUNT STUART DIVISION.

C. C. WILSON
11-10-31
CONSERVATOR OF FORESTS
WORKING PLANS CIRCLE
OOTACAMUND

DRAWN BY
G. SREENIYASALU RAJU.
DRAFTSMAN.

Reg. No. 29/1
Copies 90.

Helio-Zinco., Central Survey Office, Madras.
1933.